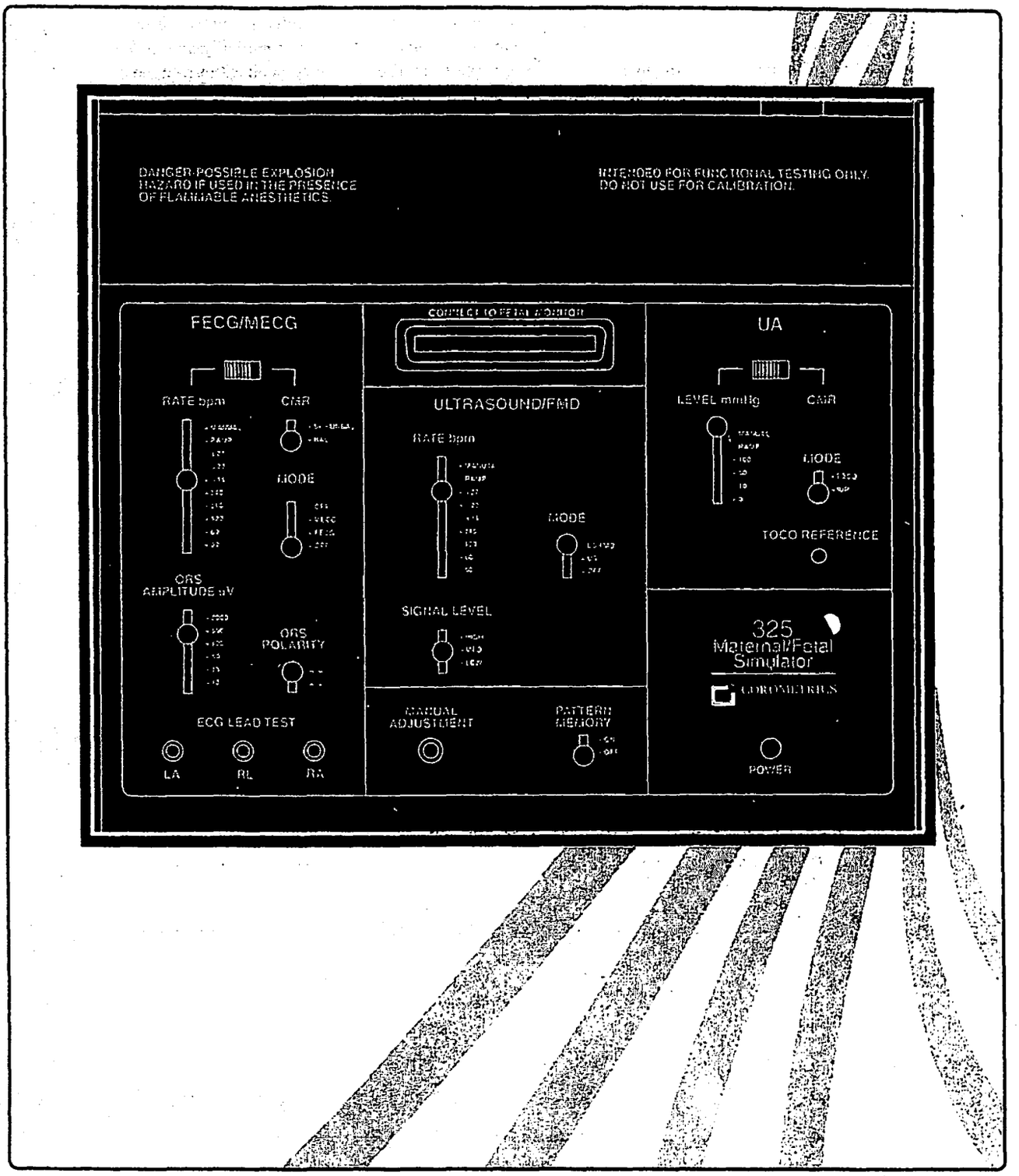
Model 325

MATERNAL/FETAL SIMULATOR **PRODUCT MANUAL P/N 14205AA-000**



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Our obligation under this guarantee is limited to repairing, or, at our option, replacing any defective parts of our equipment, except fuses or batteries, without charge, if such defects occur in normal service.

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GE Medical Systems *Information Technologies* will make available on request such circuit diagrams, component diagrams, component parts lists, descriptions, calibration instructions, or other information which will assist the users or appropriately qualified technical personnel to repair those parts of the equipment which are classified by GE Medical Systems *Information Technologies* as repairable.

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⚠ Safety

The information presented in this section is important for the safety of the operator and also serves to enhance equipment reliability. This chapter describes how the terms Danger, Warning, Caution, Important, and Note are used throughout the manual. In addition, Corometrics' standard equipment symbols are defined.

This section includes the following important information:

General Use 1-2
Responsibility of the Manufacturer 1-2
Definitions of Terminology 1-2
Definitions of Symbols 1-4

SECTION

1

GENERAL USE

If the simulator is cold to the touch or below ambient temperature, allow it to stabilize before use.

To ensure patient safety, use only parts and accessories manufactured or recommended by Corometrics Medical Systems, Inc.

Periodically, and whenever the integrity of the simulator is in doubt, test all functions.

RESPONSIBILITY OF THE MANUFACTURER

Corometrics Medical Systems, Inc. is responsible for the effects on safety, reliability, and performance if:

- assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by Corometrics Medical Systems, Inc.;
- the electrical installation of the relevant room complies with the requirements of appropriate regulations; and
- the simulator is used in accordance with the instructions of use.

DEFINITIONS OF TERMINOLOGY

Five types of special notices are used *throughout* this manual. They are: Danger, Warning, Caution, Important, and Note. The warnings and cautions in this Safety section relate to the equipment in general and apply to all aspects of the monitor. Be sure to read the other chapters because there are additional warnings and cautions which relate to specific features of the monitor.

When grouped, warnings and cautions are listed alphabetically and do not imply any order of importance.

Danger

A **DANGER** notice indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

Warning

A **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Caution

A **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. Cautions are also used to avoid damage to equipment.

Important

An **IMPORTANT** notice indicates an emphasized note. It is something you should be particularly aware of; something not readily apparent.

Note

A **NOTE** indicates a particular point of information; something on which to focus your attention.

MONITOR SAFETY INFORMATION

⚠ WARNINGS ⚠

ACCIDENTAL SPILLS—In the event that fluids are accidentally spilled on the simulator, take the simulator out of operation and inspect for damage.

ELECTRICAL SHOCK—To reduce the risk of electrical shock, do not remove simulator cover. Refer servicing to qualified personnel.

ELECTROMAGNETIC INTERFERENCE—Be aware that strong electromagnetic fields may interfere with simulator/monitor operation. Interference prevents the clear reception of signals by the monitor. If the hospital is close to a strong transmitter such as TV, AM or FM radio, police or fire stations, a HAM radio operator, an airport, or cellular phone, their signals could be picked up as signals by the monitor. If you feel interference is affecting the monitor, contact your Corometrics Service Representative to check the monitor in your environment.

ELECTROSURGERY—The simulator is not designed for use with high-frequency surgical devices. In addition, measurements may be affected in the presence of strong electromagnetic sources such as electrosurgery equipment.

EXPLOSION HAZARD—Do not use this equipment in the presence of flammable anesthetics or inside an oxygen tent.

GROUNDING—Do not defeat the three-wire grounding feature of the power cord by means of adaptors, plug modifications, or other methods. A dangerous shock hazard to the operator may result.

PATIENT CONNECTION—Do not connect the simulator to a monitor that is being used to monitor a patient.

⚠ CAUTIONS ⚠

ANNUAL SERVICING—For continued safety and performance of the monitor, it is recommended that the calibration, accuracy, and electrical safety of the monitor be verified on an annual basis by a Corometrics Service Representative.

CALIBRATION—The Model 325 Simulator is not a calibration device. It cannot be used to calibrate a monitor or to compare measurements.

ENVIRONMENT—The performance of the simulator has not been tested in certain areas, such as x-ray and imaging suites. The simulator is not recommended for use in these environments.

PERFORMANCE—Report all problems experienced with the simulator or monitor under test. If the simulator or monitor is not working properly, contact your Corometrics Service Representative for service. The simulator or monitor should not be used if it is not working properly.

DEFINITIONS OF SYMBOLS

The following is a list of symbols used on Model 325 Simulators manufactured by Corometrics Medical Systems, Inc.

⚠ Attention: Consult accompanying documents.

~ Alternating current (AC).

⏤ Fuse.

0 Power OFF: disconnection from the mains.

I Power ON: connection to the mains.

Introduction

This section describes the intended use of a Model 325 Simulator as well as a list of features:

This section summarizes the Model 325 Simulator:

Intended Uses 2-3
Features 2-3

SECTION

2

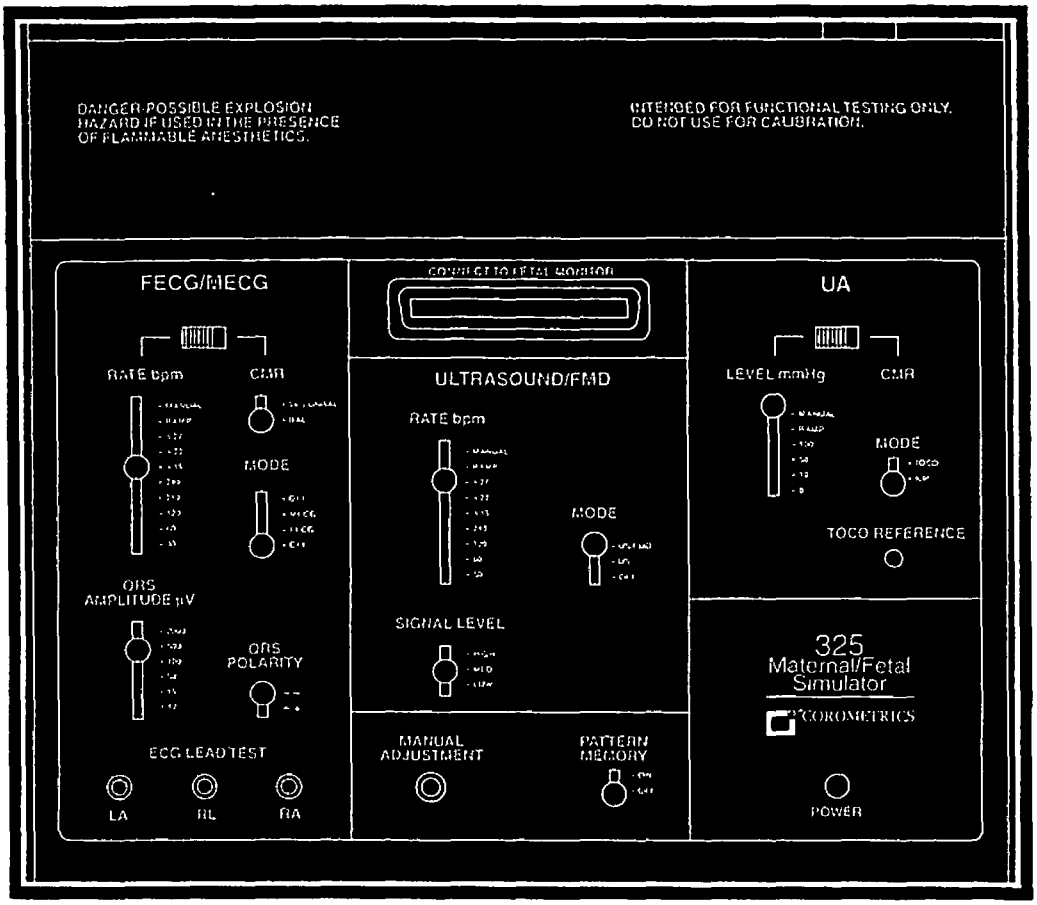


Figure 2-1. Model 325 Simulator Front Panel

INTENDED USES

The Corometrics Model 325 Maternal/Fetal Simulator, shown in Figure 2-1, provides electronically generated input signals for ensuring the proper function of a Corometrics Maternal/Fetal Monitor. It can be used by service personnel to establish basic monitor functions—it cannot be used to calibrate or compare measurements. The simulator does not have sufficient accuracy or repeatability.

The Model 325 Simulator is also helpful in demonstrating the features of a maternal/fetal monitor.

Signals are provided for verifying the functionality of the following operating modes:

- FECG (fetal electrocardiograph)
- MECG (maternal electrocardiograph)
- US or US2 (ultrasound)
- FMD (fetal movement detection)
- TOCO (tocotransducer)
- IUP (intrauterine pressure)

The simulator is designed to provide signals for the following monitors:

- Model 150 Fetal Monitor
- Model 151 Fetal Monitor
- Model 155 Fetal Monitor
- Model 116 Fetal Monitor
- Model 118 Maternal/Fetal Monitor
- 120 Series Maternal/Fetal Monitor

FEATURES

The following is a list of the Model 325 Simulator's most outstanding features:

- Dual heart rate capability for generation of two different heart rates, simultaneously—US and FECG or US and MECG.
- Generation of fetal movement detection.
- Rate and level controls for verification of monitor performance.
- Internal memory stores 34 minutes of typical heart rate and uterine activity patterns.
- Line powered for operation without the use of the Central System connector on the rear panel of the monitor.

SECTION 2

Controls, Indicators, and Connectors

This section describes all controls, indicators, and connectors on the Model 325 Simulator.

The section contains the following:

Front Panel ECG Controls 3-3
Front Panel US Controls 3-5
Front Panel UA Controls 3-7
Front Panel General Controls and Indicators 3-9
Rear Panel 3-11

SECTION

3

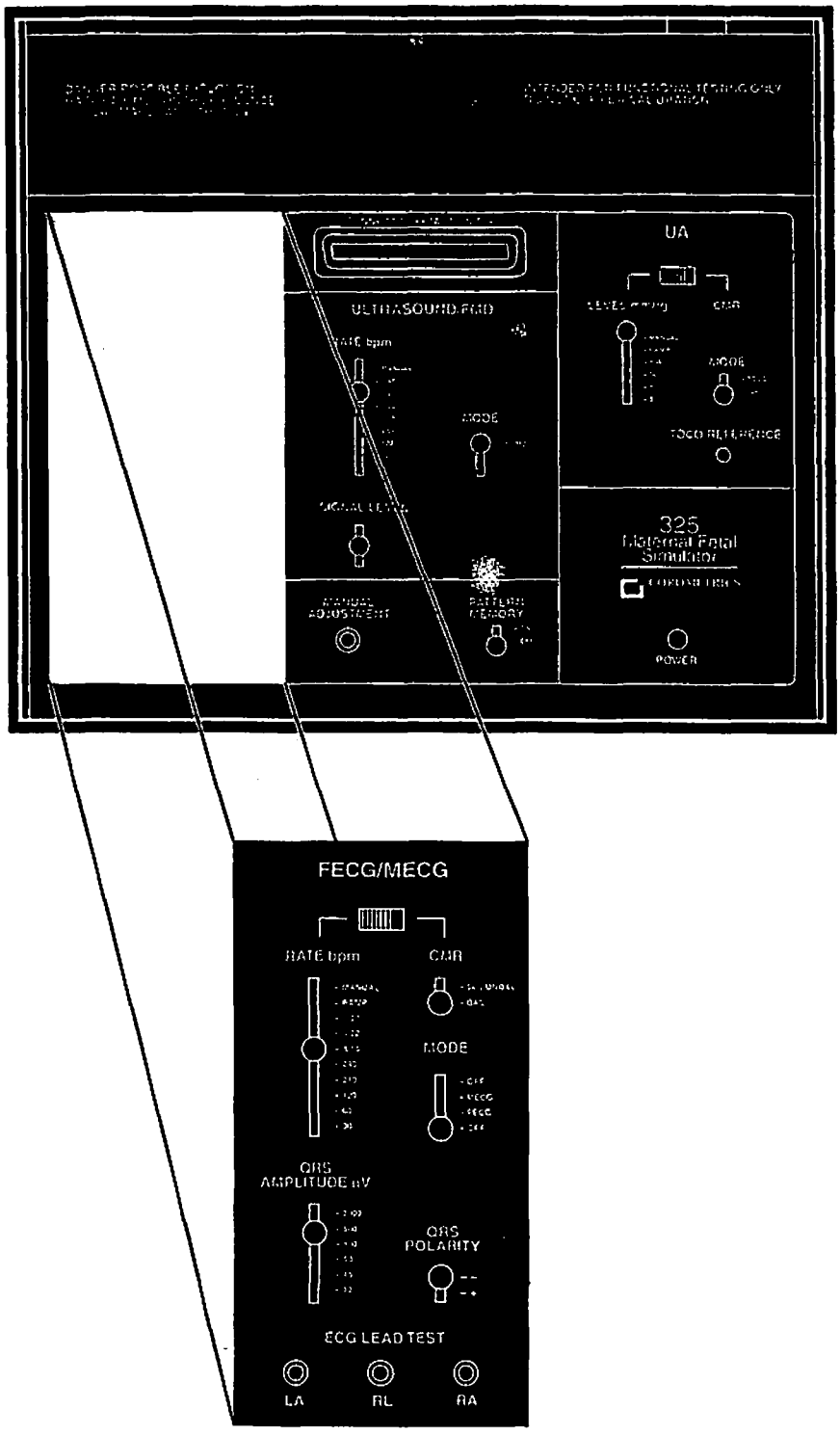


Figure 3-1. ECG Controls

FRONT PANEL ECG CONTROLS

This group of switches, shown in Figure 3-1, controls the direct fetal ECG and maternal ECG signals.

ECG Rate/CMR Switch

When this switch is in the left position, the simulator outputs an ECG waveform at the rate selected by the **ECG Rate** switch. When this switch is in the right position, the simulator outputs a 60 Hz common mode signal via the **ECG Lead Test** connectors.

ECG Rate Switch

This switch controls the QRS repetition rate.

The rate can be fixed at 30, 60, 120, 210, or 240 BPM. The beat-to-beat value is based on the R-to-R interval on the QRS complex.

The rate can also be set to oscillate centered around the 120 BPM mark; settings of Δ15, Δ22, and Δ27 BPM are provided. These settings can be used to test the maternal/fetal monitor's ECG artifact elimination functionality.

In addition, the rate can be set to produce a ramp signal between 30 and 240 BPM.

Finally the rate can be adjusted manually in conjunction with the **Manual Adjustment** knob.

ECG CMR Switch

This switch selects the resistor network used for common mode rejection testing. Select between balanced and 5 kΩ unbalanced.

ECG Mode Switch

This switch selects which ECG mode is simulated in the monitor: FECG or MECG.

ECG QRS Amplitude Switch

This switch controls the amplitude of the simulated QRS complex. The selections are: 12, 15, 50, 100, 500, or 2000 μV.

ECG QRS Polarity Switch

This switch sets the simulated R-wave polarity either positive (+) or negative (–).

ECG Lead Test Connectors

These connectors are used for common mode rejection mode testing of the MECG cable and the monitor's ECG input circuitry. (Refer to *Section 4, Operation* for detailed information about this test.)

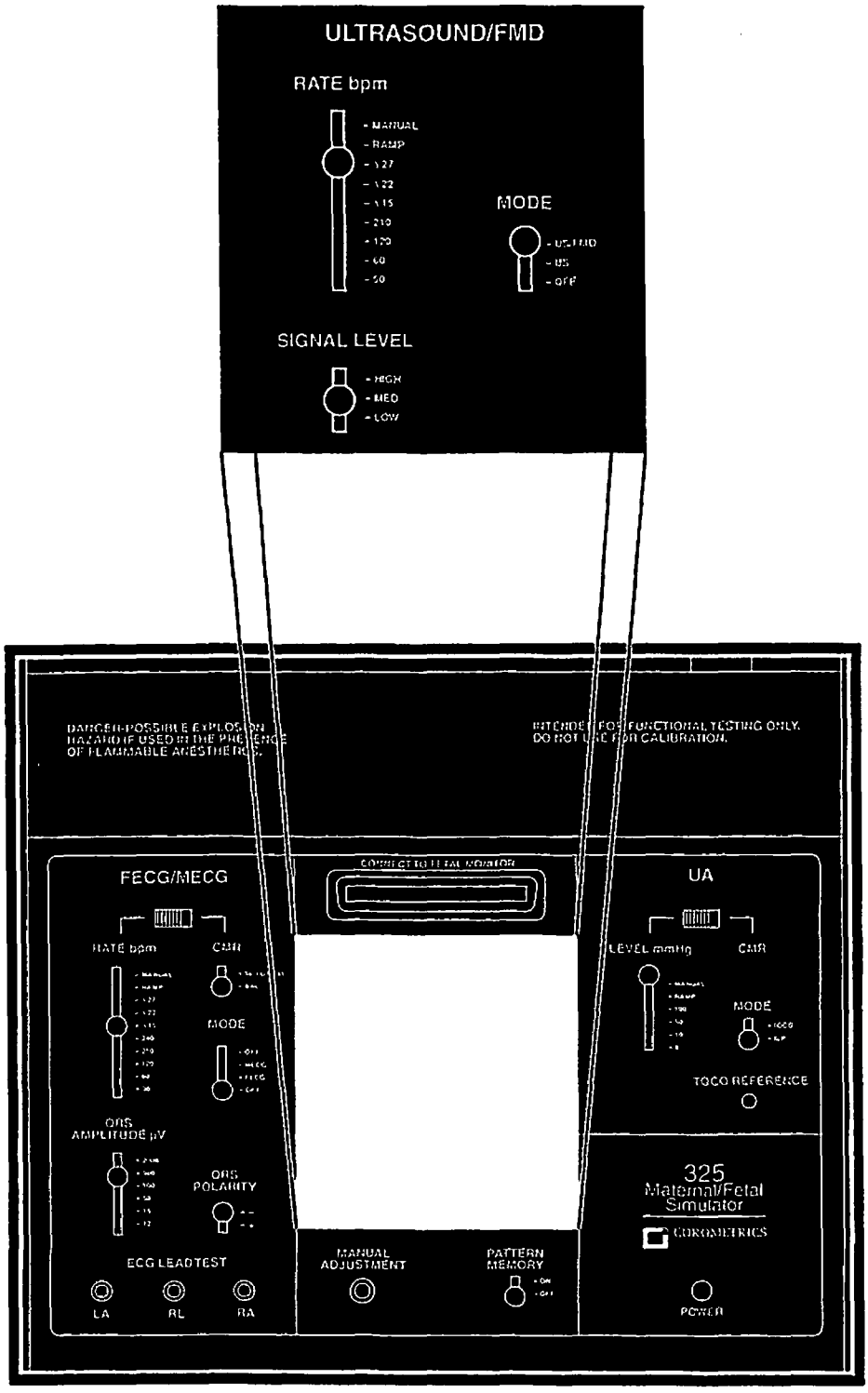


Figure 3-2. US Controls

FRONT PANEL US CONTROLS

This group of switches, shown in Figure 3-2, controls the simulated fetal movement detection and ultrasound signals.

US Rate Switch

This switch controls the rate of the simulated ultrasound signal.

The rate can be fixed at 50, 60, 120, or 210 BPM.

The rate can also be set to oscillate centered around the 120 BPM mark; settings of Δ15, Δ22, and Δ27 BPM are provided.

In addition, the rate can be set to produce a ramp signal between 50 and 210 BPM.

Finally, the rate can be adjusted manually in conjunction with the **Manual Adjustment** knob.

US Mode Switch

This switch selects the simulated signal: US or US/FMD (ultrasound with fetal movement detection). Fetal movement markers are shown on for a duration of one second, then off for eight seconds, then on for one second, etc.

US Signal Level Switch

This switch selects one of three signal level amplitudes: low, medium and high.

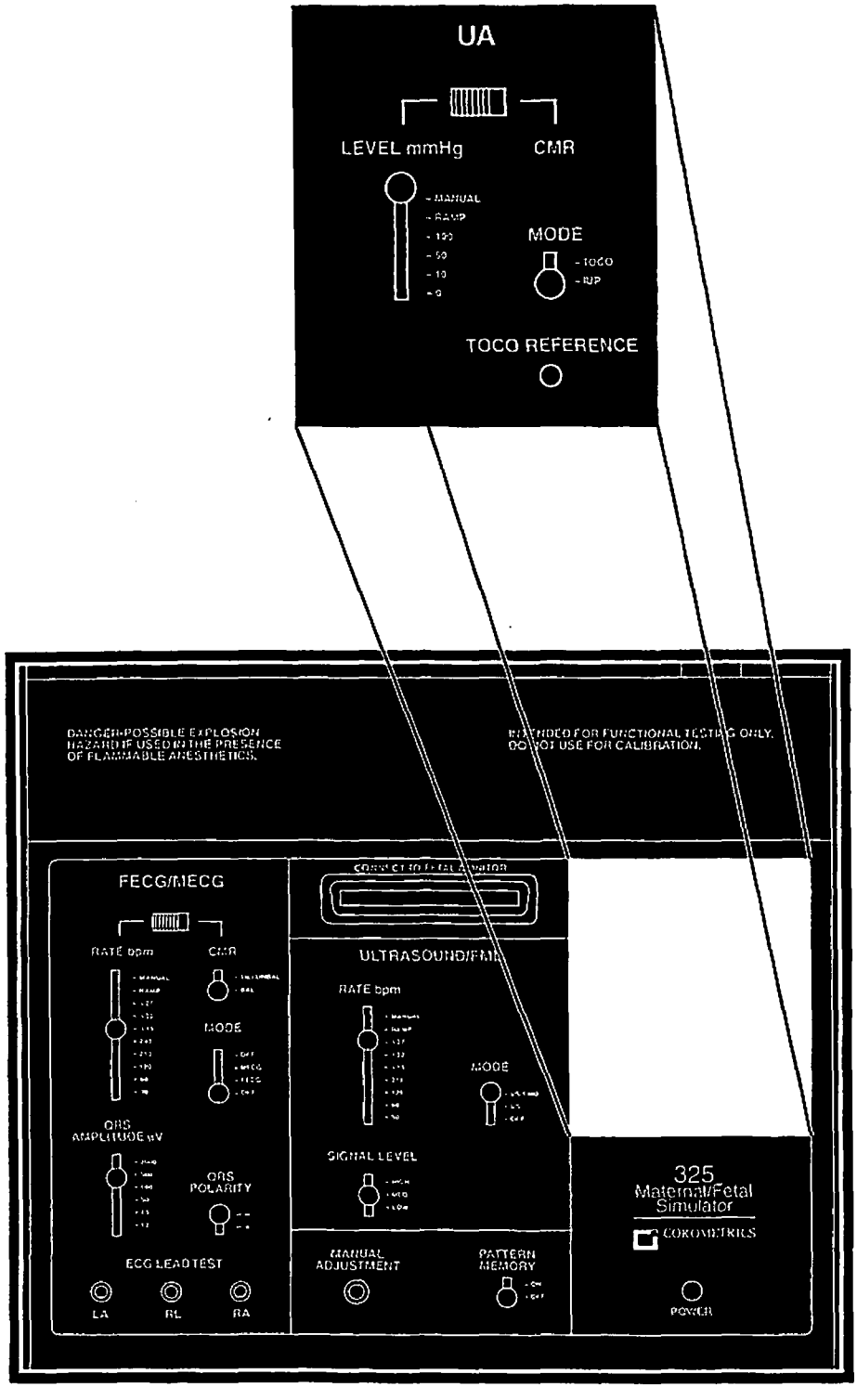


Figure 3-3. UA Controls

FRONT PANEL UA CONTROLS

This group of switches, shown in Figure 3-3, controls the simulated uterine activity signal.

UA Level/CMR Switch

When this switch is in the left position (LEVEL), the simulator outputs a pressure level selected by the **UA Level** switch. When this switch is in the right position (CMR), the simulator outputs a DC common mode signal to the monitor's **UA** connector.

UA Level Switch

This switch selects the pressure level of the TOCO or IUP signal.

The rate can be fixed at 0, 10, 50, or 100. The units represent relative units for the TOCO mode or mmHg for the IUP mode.

The rate can also be set to produce a ramp signal between 0 and 100—relative units or mmHg, depending on the selected mode.

Finally, the rate can be adjusted manually in conjunction with the **Manual Adjustment** knob..

UA Mode Switch

This switch selects which pressure mode is enabled in the monitor: TOCO or IUP.

UA TOCO Reference

This screwdriver-adjusted control causes a fixed offset to be added to all pressure levels in the TOCO mode. Normally, this control should be turned to the fully clockwise position.

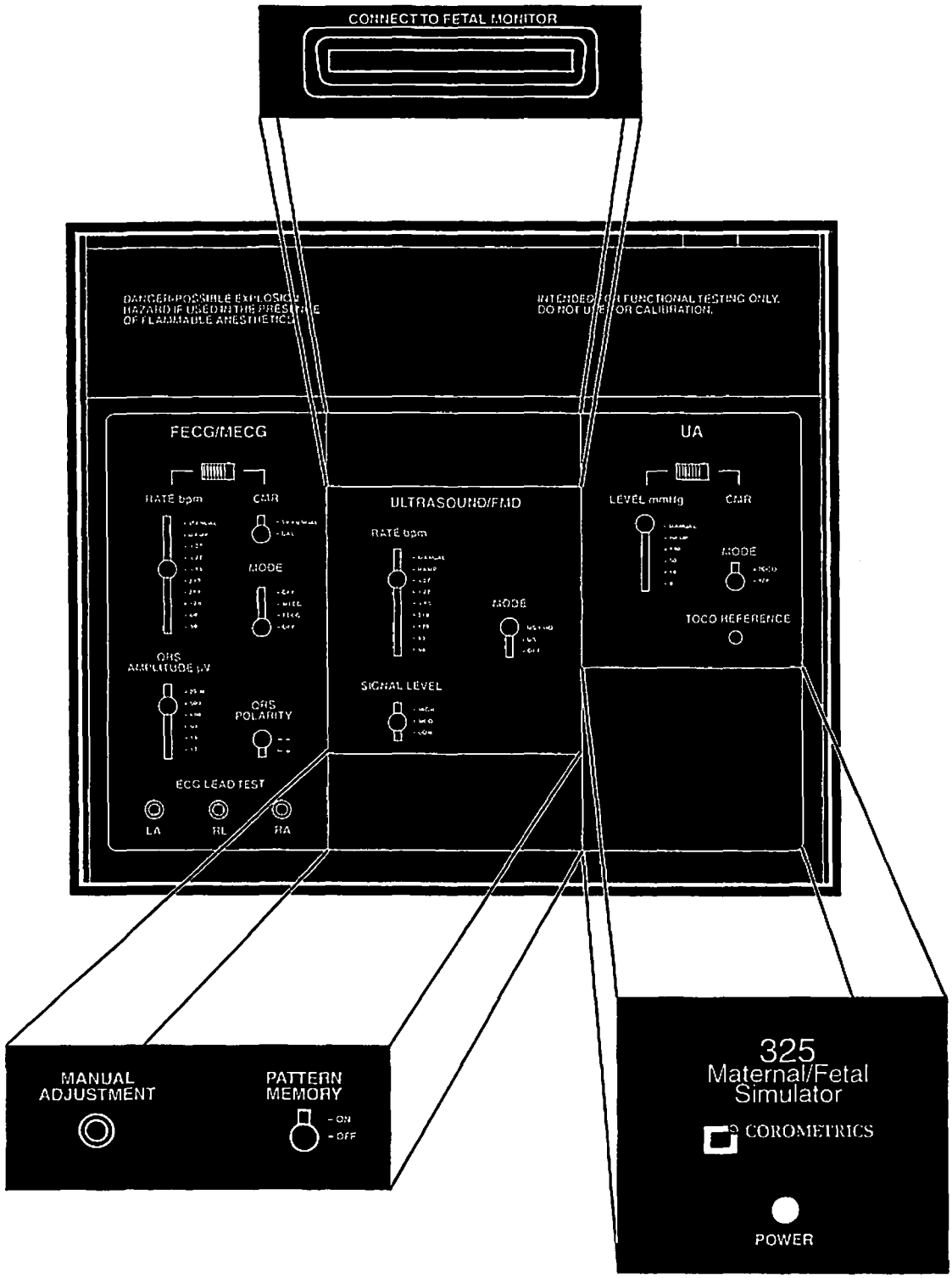


Figure 3-4. General Controls, Power LED

FRONT PANEL GENERAL CONTROLS AND INDICATORS

This group of controls and indicators is shown in Figure 3-4.

Fetal Monitor Receptacle

This receptacle, labeled **CONNECT TO FETAL MONITOR**, accepts the interconnect cable (P/N 14212A/B) for attaching to a maternal/fetal monitor.

Manual Adjustment Knob

This knob is used to manually vary the pressure level or heart rate when the corresponding **ECG Rate**, **US Rate**, or **UA Rate** switch is in the MANUAL position.

Pattern Memory Switch

When this switch is in the ON position, pre-programmed heart rate and uterine activity patterns are provided via the selected modes. The position of the **Rate** and **Level** controls are ignored in this mode. (Refer to pages 4-15 through 4-17, for the strip chart record of the pattern memory.)

Power Indicator

This green indicator illuminates when the simulator's rear panel power pushbutton is depressed (in the on position).

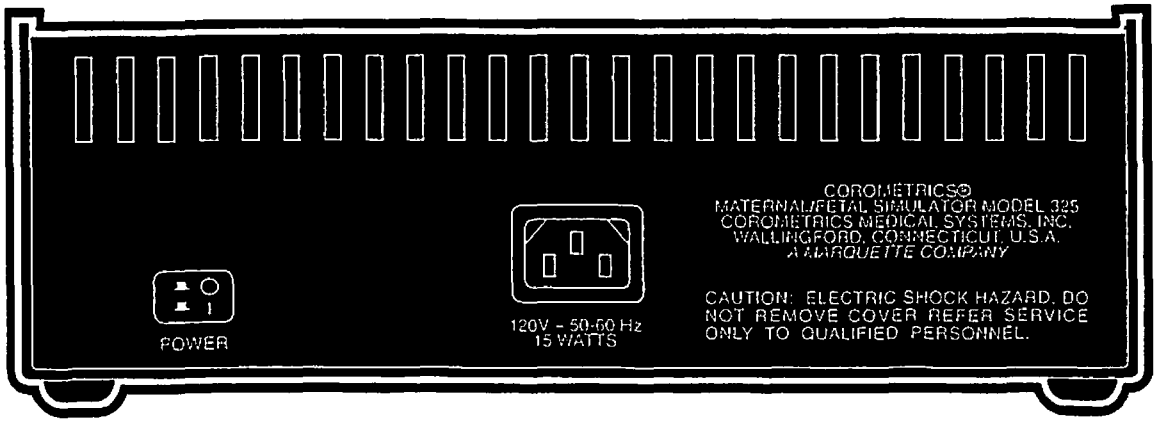

COROMETRICS®
MATERNAL/FETAL SIMULATOR MODEL 325
COROMETRICS MEDICAL SYSTEMS, INC.
WALLINGFORD, CONNECTICUT, U.S.A.
A MARQUETTE COMPANY
CAUTION: ELECTRIC SHOCK HAZARD. DO NOT REMOVE COVER REFER SERVICE ONLY TO QUALIFIED PERSONNEL.
120V - 50-60 Hz
15 WATTS
POWER

Figure 3-5. Rear Panel

REAR PANEL

There are two controls on the rear panel of the simulator. Refer to Figure 3-5.

Power Pushbutton

The power pushbutton, turns the simulator on and off. Pressing the power pushbutton (I position) turns *on* the simulator and illuminates the green power indicator. Pressing this pushbutton again (O position), turns off the simulator.

AC Line Cord Connector

This is the receptacle for the AC line power cord. Units manufactured for the United States are marked with the following power requirements: **120 V ~ 50–60 Hz, 15 WATTS.** Refer to the rear panel markings on your simulator to verify line voltage and frequency.

Operation

This section contains operating information for testing the functionality of the maternal/fetal monitor under test.

This section contains the following information:

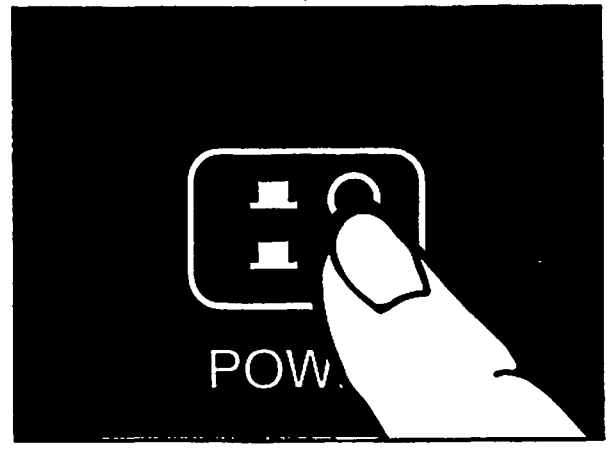
Preparing the Simulator for Use 4-2
ECG Simulation 4-4
MECG CMR Testing 4-6
US Simulation 4-8
Dual Heart Rate Simulation (US and ECG) 4-10
UA Simulation 4-11
UA CMR Testing 4-13
Pattern Memory 4-14

SECTION

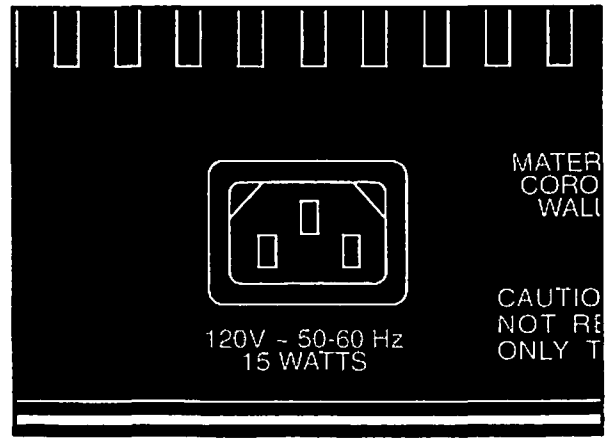
4

PREPARING THE SIMULATOR FOR USE

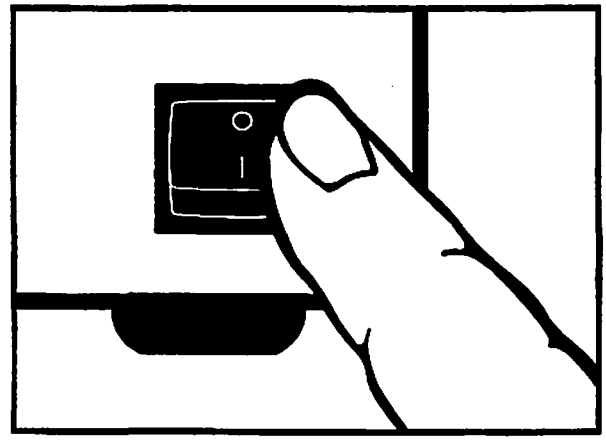
1. Ensure the Model 325 Simulator **Power** switch is in the *off* position.



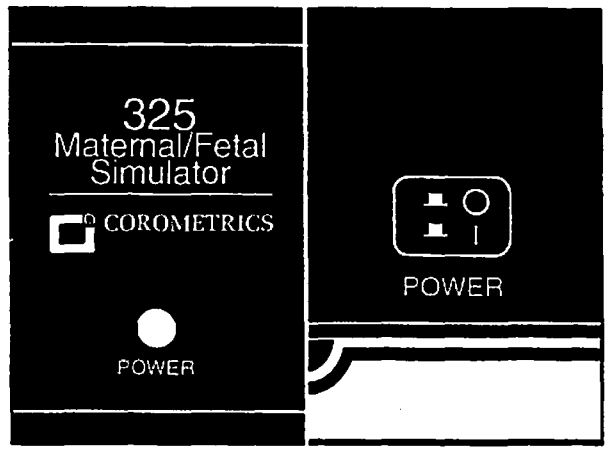
2. Connect the detachable line cord to the rear panel power connector; plug the other end into a hospital-grade grounded wall outlet of appropriate voltage.



3. Ensure the *monitor* **Power** switch is in the *off* position.
4. Connect one end of the interconnect cable to the simulator's **Fetal Monitor** connector.
5. Connect the sub-cables of the other end into the desired color-coded connectors on the maternal/fetal monitor: **FECG/MECG, US,** and **UA.**
6. Turn *on* the maternal/fetal monitor.



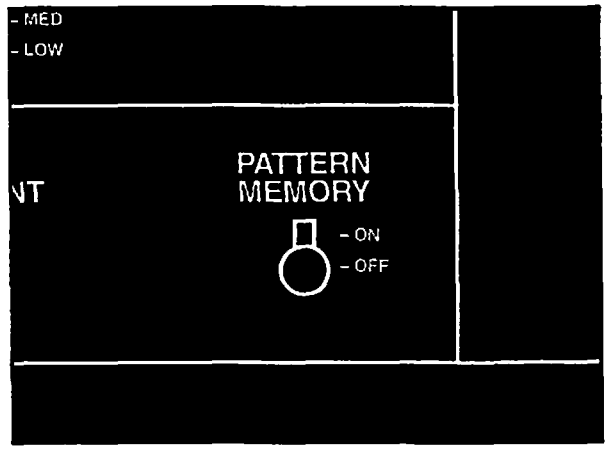
7. Turn *on* the Model 325 Simulator. Verify that the green Power indicator illuminates.



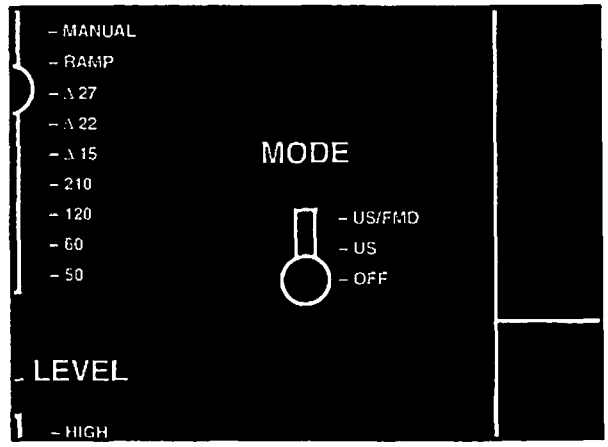
ECG SIMULATION

The Model 325 can provide FECG or MECG simulations.

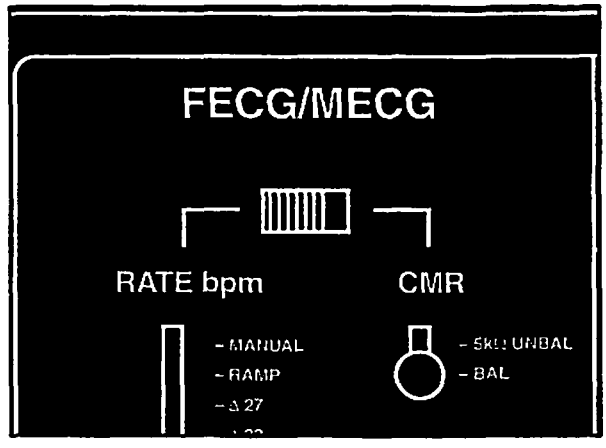
1. Set the **Pattern Memory** switch to OFF.



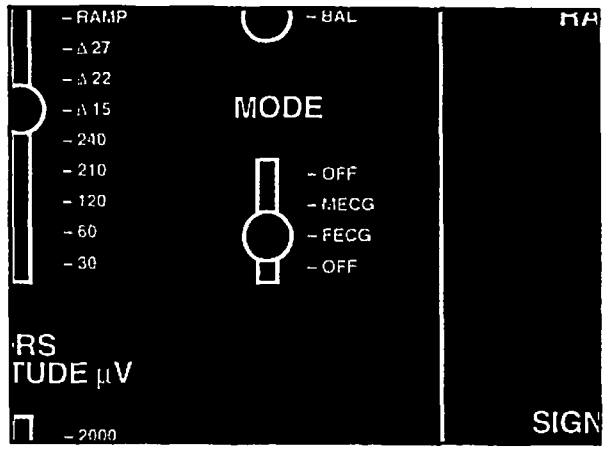
2. Set the **US Mode** switch to OFF.



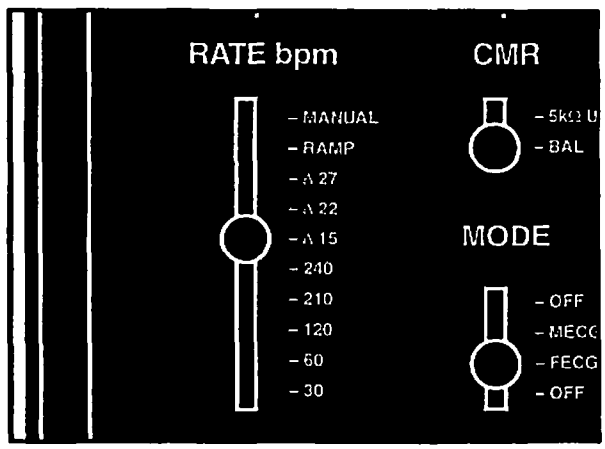
3. Set the **ECG Rate/CMR** switch to the left position (RATE).



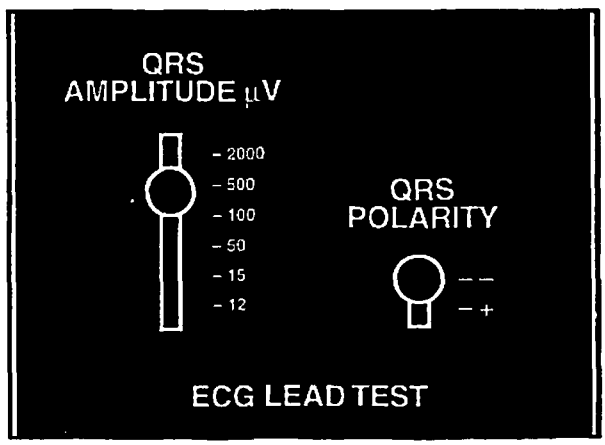
4. Set the **ECG Mode** switch to either FECG or MECG as desired.



5. Set the **ECG Rate** switch to the desired rate. (Refer to *Section 3, Controls, Indicators, and Connectors*, for information about the selections.)



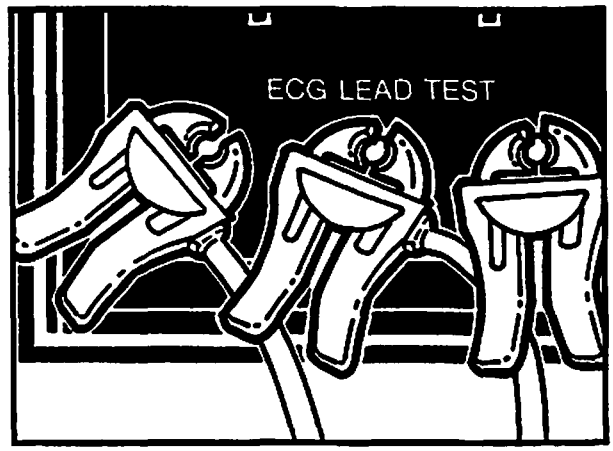
6. Set the **ECG QRS Amplitude** and **ECG QRS Polarity** switches as desired. (Refer to *Section 3, Controls, Indicators, and Connectors*, for information about the selections.)



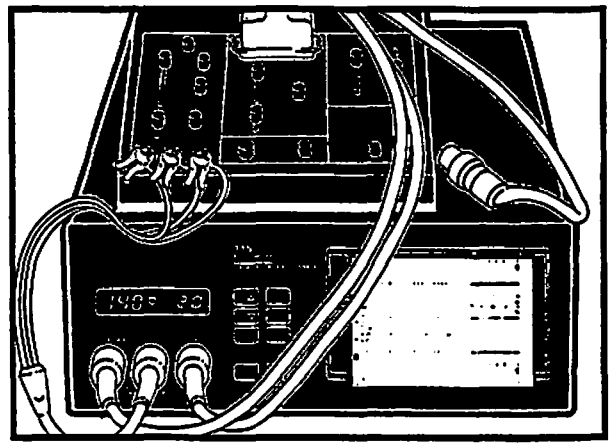
MECG CMR TESTING

The Model 325 Simulator provides a signal for evaluating common mode rejection in the maternal/fetal monitor being tested.

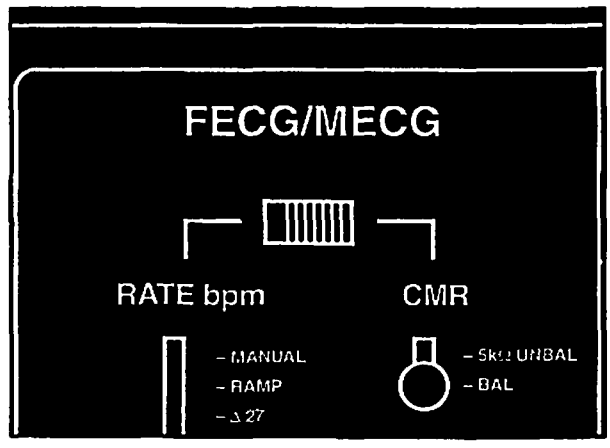
1. Set the controls as described previously under *ECG Simulation*, selecting MECG as the mode.
2. Connect the three leadwires of the MECG cable being tested to the **ECG Lead Test** connectors. Attach the white leadwire to the **RA** connector; attach the black leadwire to the **LA** connector; attach the remaining leadwire to the **RL** connector.



3. Disconnect the ECG connector of the interconnect cable from the monitor's **MECG** or **ECG** connector. Plug the MECG cable being tested into the monitor's **MECG** or **ECG** connector.

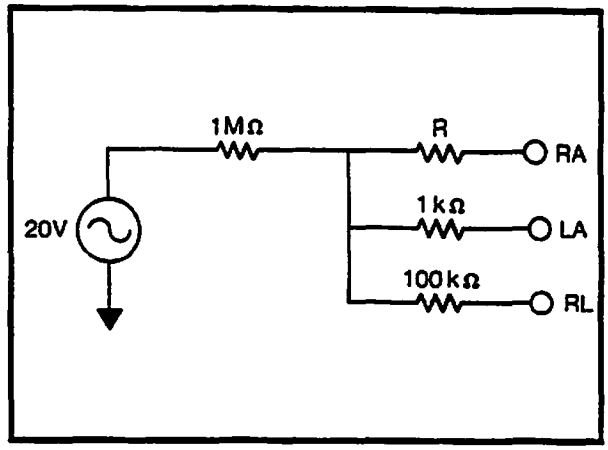


4. Set the **ECG Rate/CMR** switch to the right position (CMR).



5. Select the desired resistor value via the **ECG CMR** switch. A 20 V peak-to-peak sine wave at line frequency is applied to the ECG inputs of the monitor through the circuit shown to the right. When the CMR switch is in the BAL position, the value of the resistor marked R is 1 kΩ. When the CMR switch is in the 5 kΩ UNBAL position, the value of R is 6 kΩ.

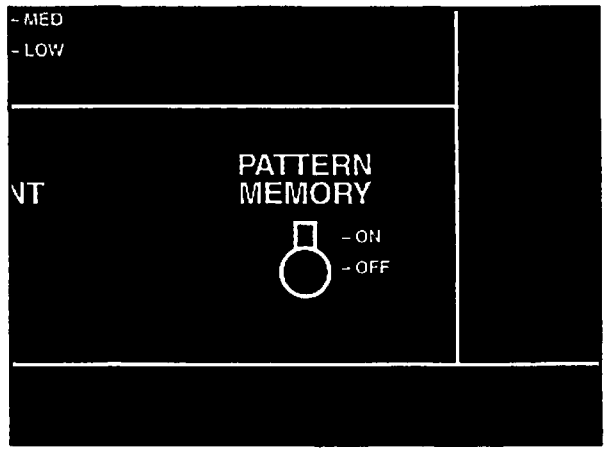
   Refer to the common mode rejection specifications in the service manual for the maternal/fetal monitor being tested.



US SIMULATION

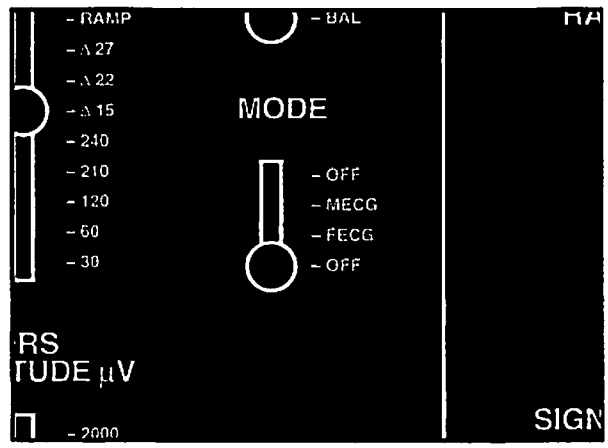
The Model 325 can provide ultrasound simulation with or without an accompanying fetal movement simulation.

1. Set the **Pattern Memory** switch to OFF.



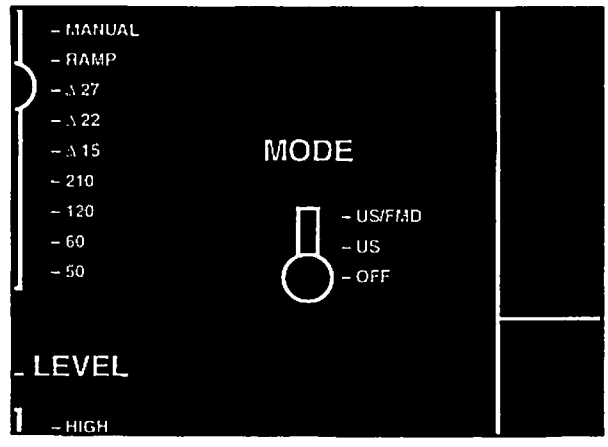
2. Set the **ECG Mode** switch to OFF.

   NOTE: There are two OFF positions—either position can be used.

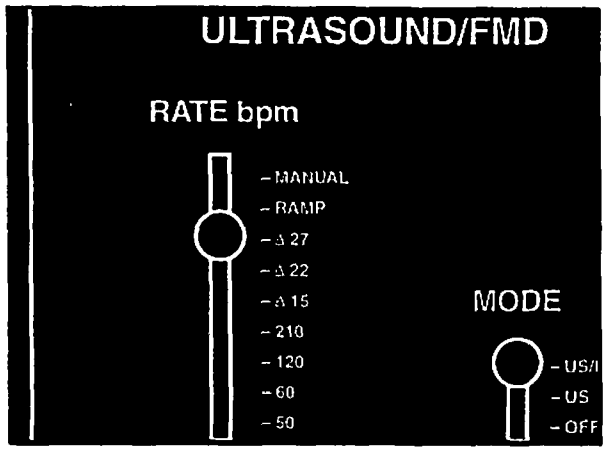


3. Set the **US Mode** switch to US or US/FMD as desired. (Refer to *Section 3, Controls, Connectors, and Indicators*, for information about the selections.)

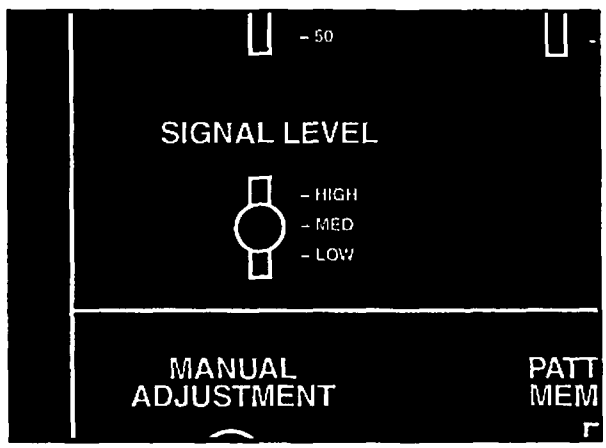
   NOTE: Fetal movement detection simulation only works with monitors equipped with fetal movement detection circuitry. Refer to the respective operator's manual to determine if a maternal/fetal monitor is equipped with fetal movement detection features.



4. Set the **US Rate** switch to the desired setting. (Refer to *Section 3, Controls, Indicators, and Connectors*, for information about the selections.)



5. Set the **Signal Level** switch to LOW, MED, or HIGH as desired.

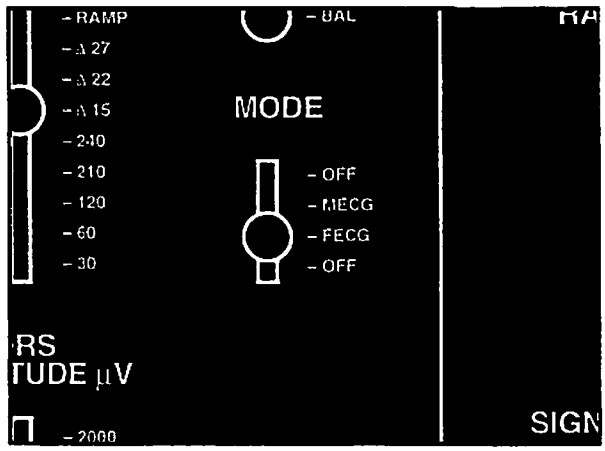


DUAL HEART RATE SIMULATION (US AND ECG)

This procedure is used to simulate dual heart rate signals—ultrasound and FECG or ultrasound and MECG.

NOTE: This simulation applies only to monitors equipped with dual-cardiotach functionality.

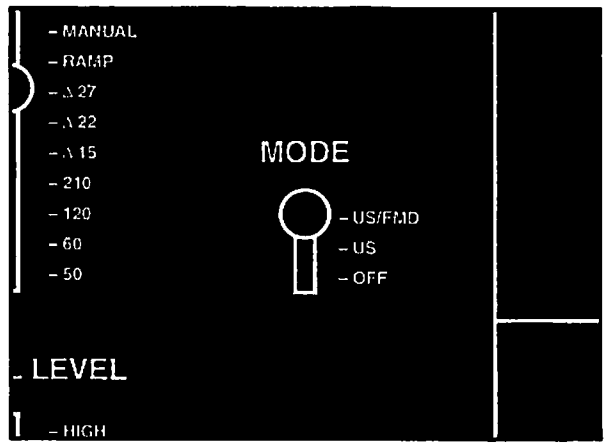
1. Set the **ECG Mode** switch to FECG or MECG as desired.



2. Set the **US Mode** switch to US or US/FMD as desired.

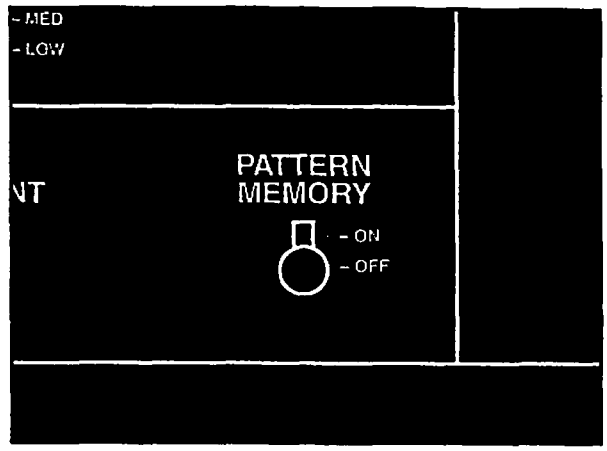
   NOTE: Fetal movement detection simulation only works with monitors equipped with fetal movement detection features. Refer to the respective operator's manual to determine if a maternal/fetal monitor is equipped with fetal movement detection features.

3. Set the remaining switches as described previously under *ECG Simulation* and *US Simulation*.

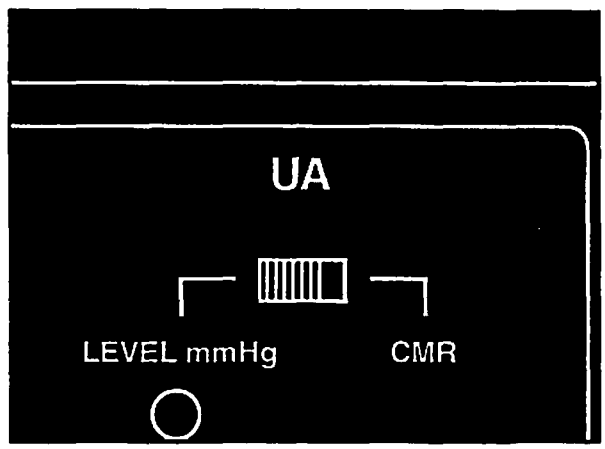


UA SIMULATION

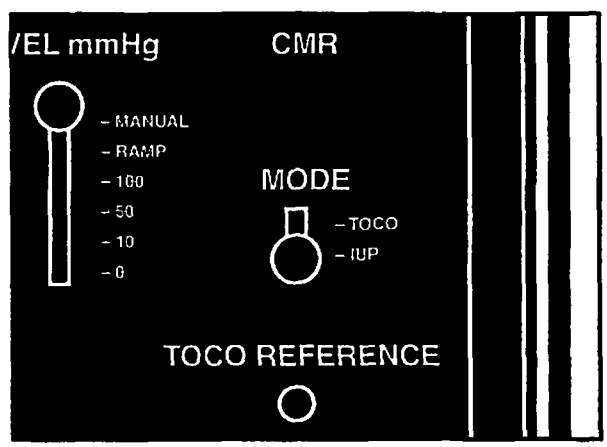
1. Set the **Pattern Memory** switch to OFF.



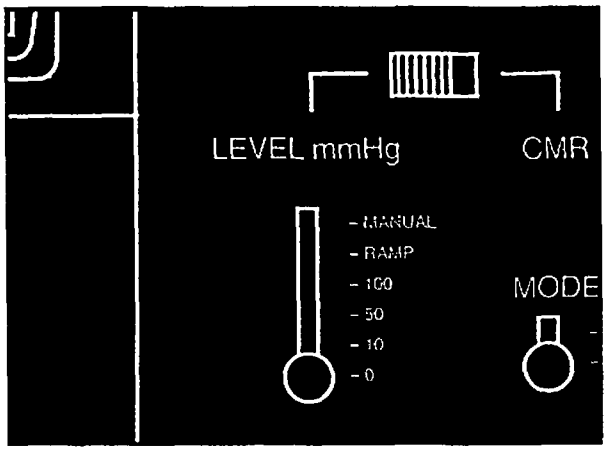
2. Set the **UA Level/CMR** switch to the left position (LEVEL).



3. Set the **UA Mode** switch to either IUP or TOCO as desired.

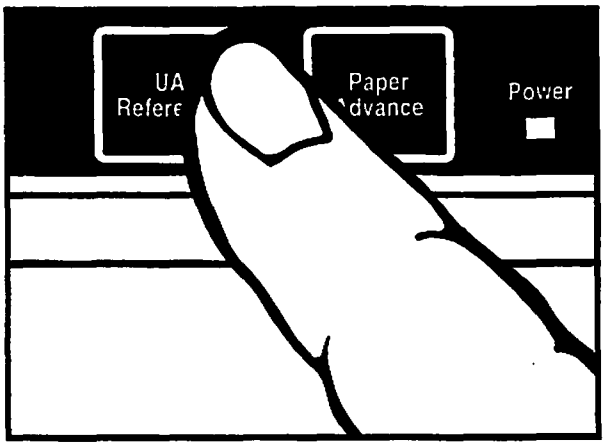


4. Set the **UA Level** switch to 0. (The units represent mmHg or relative units for the modes IUP and TOCO, respectively.)

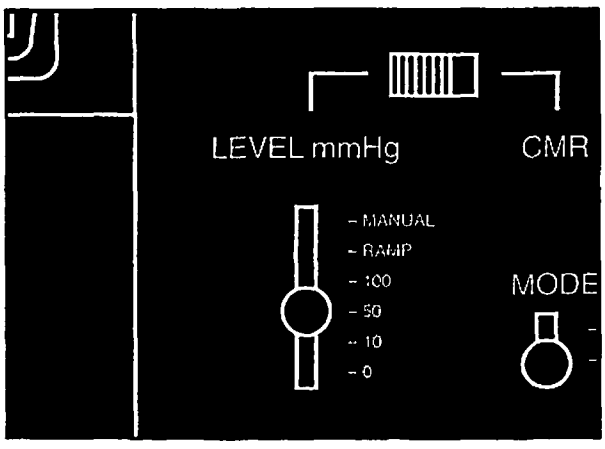


5. Briefly press the *monitor's* **UA Reference** pushbutton to set the UA baseline at the monitor's *default* setting.

   NOTE: For the IUP mode, the baseline is always set at 0 mmHg. For the TOCO mode, most monitors *default* to 10 relative units. However, some monitors allow the *default* baseline to be configured to another value. Refer to the respective operator's manual for more information.



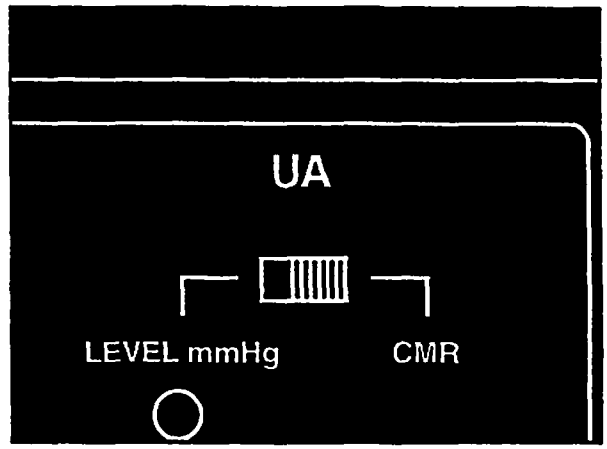
6. Set the **UA Level** switch to the desired pressure level. (Refer to *Section 3, Controls, Indicators, and Connectors*, for information about selections.)



UA CMR TESTING

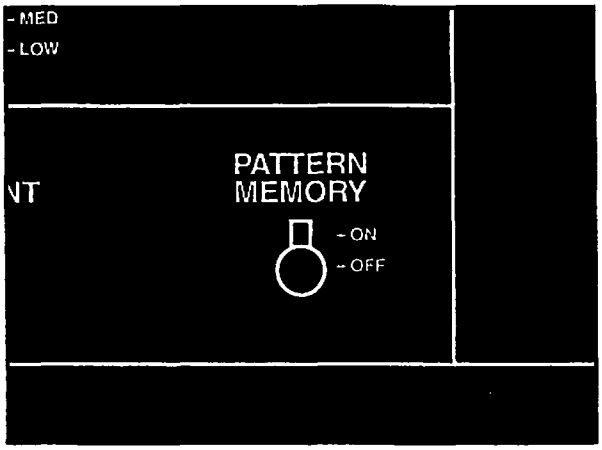
The Model 325 Simulator provides a signal for common mode rejection testing in the maternal/fetal monitor being tested. Refer to the common mode rejection specifications provided in the monitor's service manual.

1. Set the **UA Level/CMR** switch to the right position (CMR).
2. A 0.1 Vdc signal (derived from the 4 V excitation reference of the monitor being tested) is applied to both the positive and negative inputs of the pressure amplifier.



PATTERN MEMORY

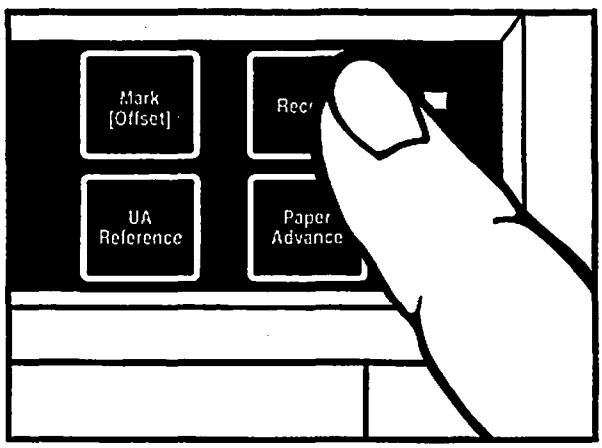
The pattern memory simulation uses heart rate and uterine activity data stored in the simulator's internal memory. Thirty four minutes of typical heart rate and uterine activity patterns are provided—then the pattern repeats. (Refer to Figures 4-1, 4-2, and 4-3.) Three different heart rate patterns are stored: one for FECG, one for MECG, and one for US. The appropriate patterns selected by the **Mode** switches are simulated.

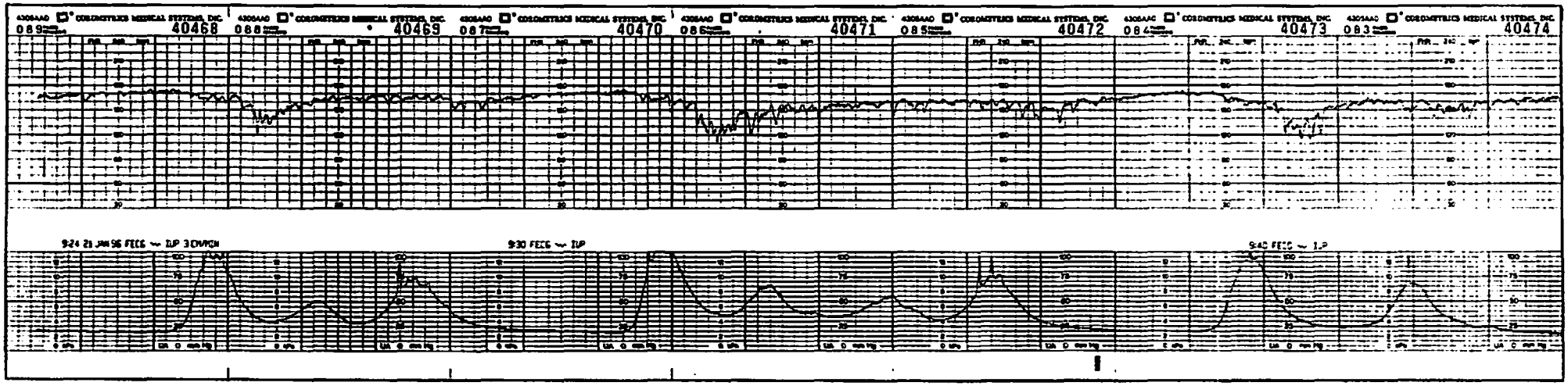


1. Set the **ECG Mode**, **US Mode**, and **UA Mode** switches as desired.
2. Set the Pattern Memory switch to ON. The positions of the **Level** switches are ignored.

   NOTE: To restart the pattern from the beginning, at any time, turn the Model 325 Simulator *off* then *on* again.

3. Turn on the maternal/fetal monitor's recorder.





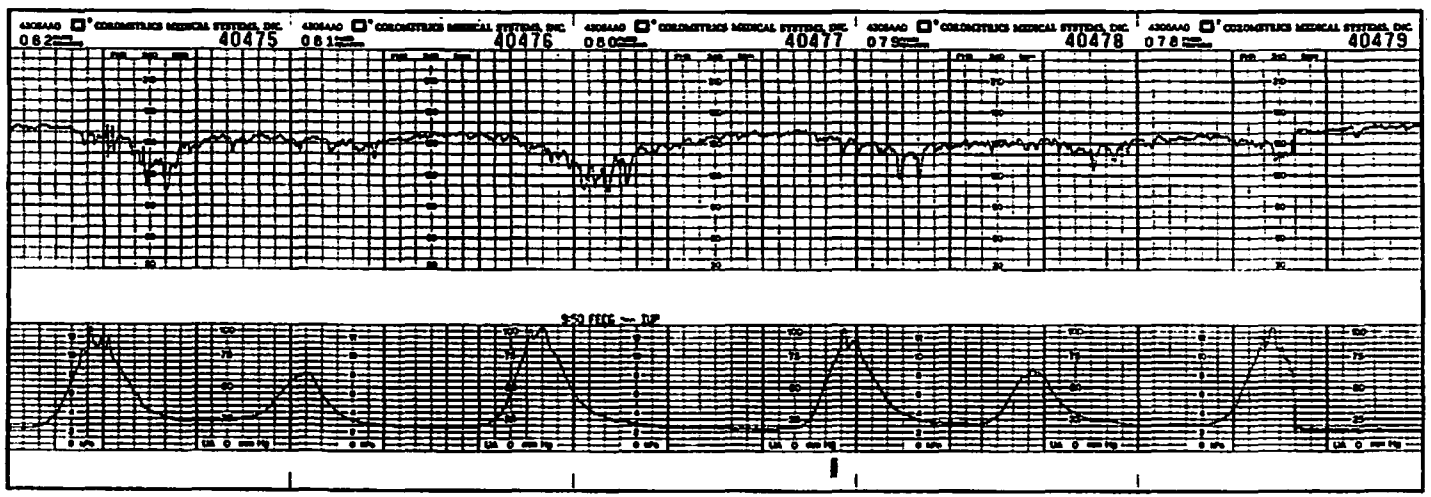
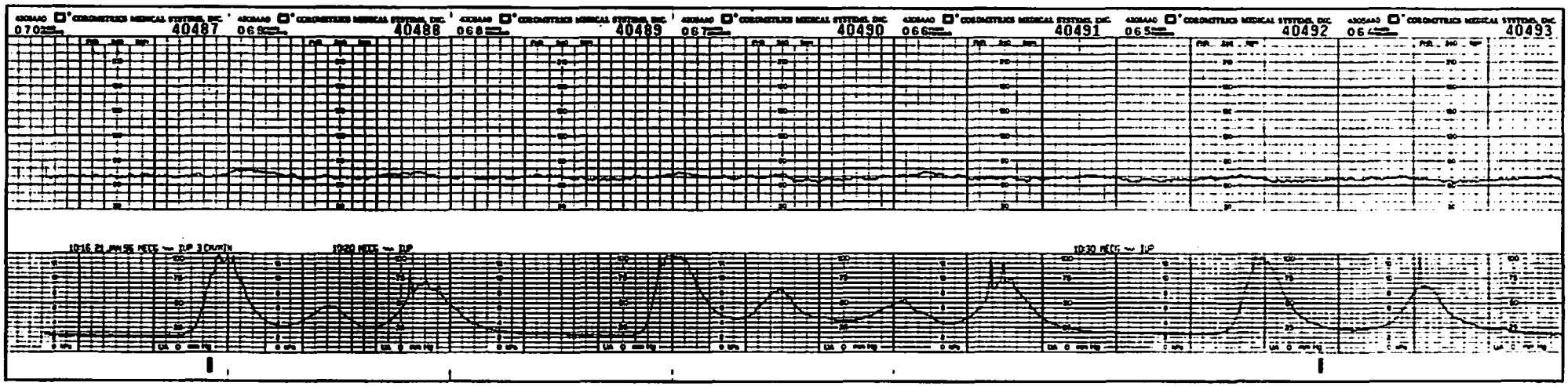


Figure 4-1. FECG and IUP Patterns



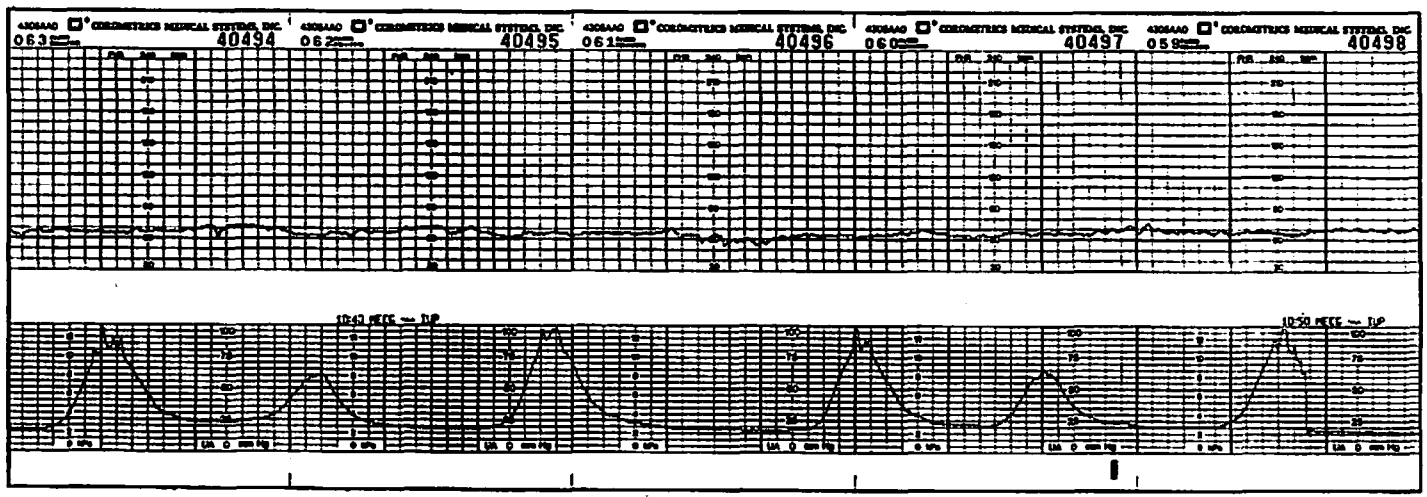
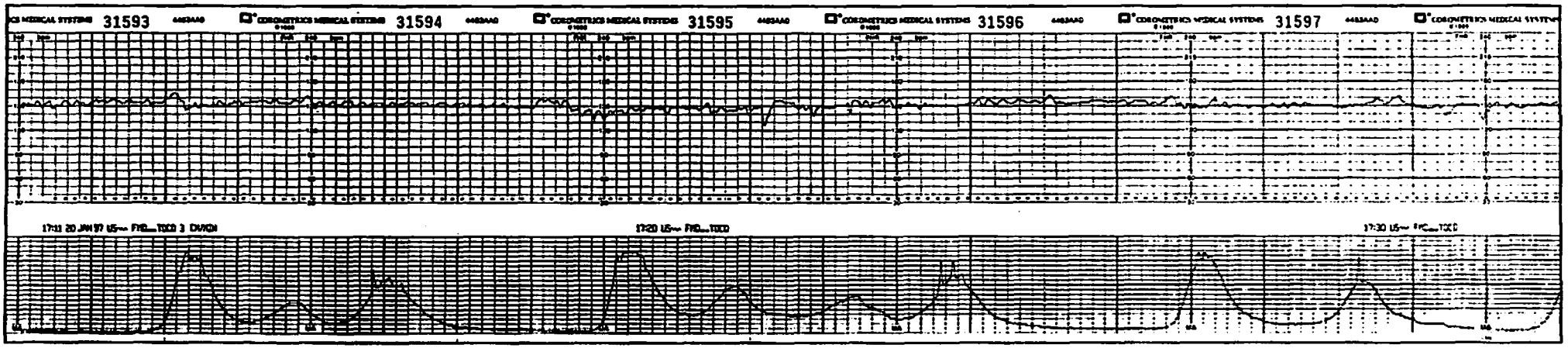


Figure 4-2. MECG and IUP Patterns



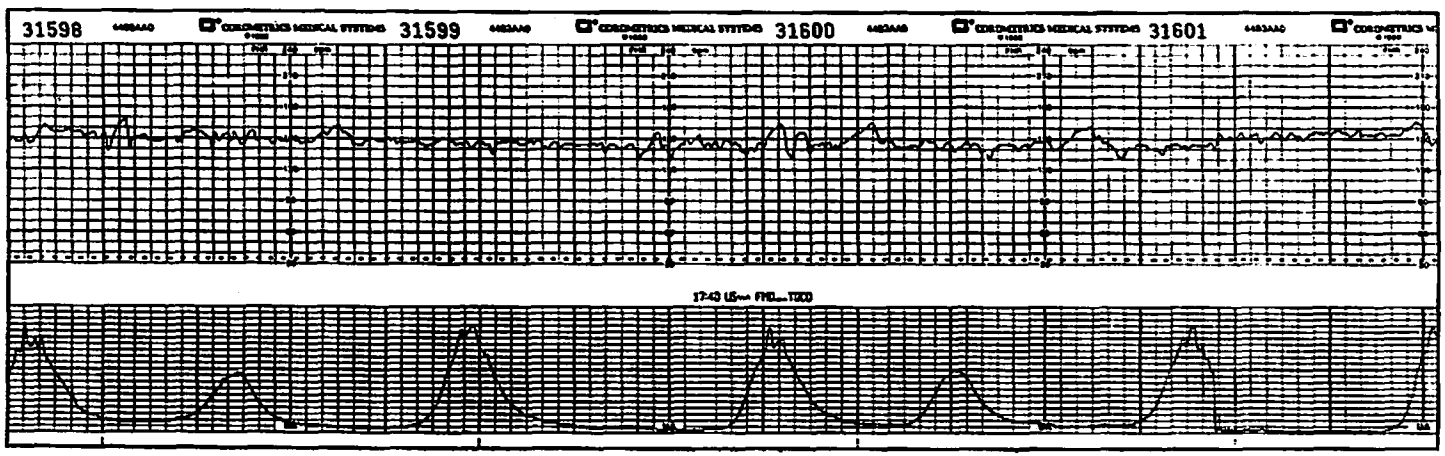


Figure 4-3. US/FMD and TOCO Patterns

Care and Cleaning

All equipment, no matter how reliable, needs to be maintained on a regular basis. This section describes care and cleaning instructions for the Model 325 Simulator.

⚠ CAUTION ⚠

Unplug the simulator from the AC power source and disconnect from the maternal/fetal monitor. Do not use abrasive cloth or cleaners.

This chapter describes the following monitoring methods:

General 5-2
Cleaning 5-2
Inspection 5-2

SECTION

5

SECTION 5

GENERAL

Cleaning and inspection are important functions that should be performed routinely to ensure continued safe, efficient operation of the simulator.

CLEANING

1. Unplug the Model 325 Simulator from AC power and disconnect from the maternal/fetal monitor.
2. Dampen a soft cloth with a mild soap and water solution. Gently rub soiled areas on the simulator exterior until clean.

> ⚠ CAUTION ⚠
>
> Do not allow liquids to enter the openings around the switches.

3. Wipe simulator dry with a clean, soft cloth.

INSPECTION

1. Check the overall appearance and physical condition of the simulator for signs of any obvious damage.
2. Inspect the interconnection cable and AC power cord for cracking and fraying.
3. Inspect the AC power cord plug for broken or bent prongs.

Troubleshooting

This section of the manual provides a troubleshooting guide for the most basic Model 325 Simulator operational problems. If the response to a specific question is not found, contact the Corometrics Service Department at one of the following numbers:

Inside the United States: 1-800-808-CORO (2676)

Outside the United States: 203-949-2498;
or contact your local distributor.

This chapter contains the following:

General 6-2
Simulator Self-Test Procedure 6-2

SECTION

6

SECTION 6

GENERAL

If you suspect a problem with the Model 325 Simulator:

1. First verify proper operation of the monitor being tested—use transducers and the monitor's self-test procedure. Refer to the operator's manual and service manual of the maternal/fetal monitor.
2. Verify continuity of each wire in the interconnect cable assembly. Refer to the cable wiring diagram (14212TAB) on page 9-19.
3. Perform a Model 325 Simulator self-test procedure, described below.
4. Refer to Table 6-1 for a list of problems which may be caused by improper settings of the controls.

SIMULATOR SELF-TEST PROCEDURE

1. Turn off the Model 325 Simulator and remove the AC line cord from the simulator.
2. Disconnect the simulator from the maternal/fetal monitor under test.
3. Turn the simulator upside down and locate the four screws which secure the top cover to the bottom. Use a Phillips screwdriver to remove them.
4. Gently separate the top and bottom halves of the simulator by sliding the top cover toward the rear and lifting it up. The CPU and Power Supply Board (No. 7093) remains mounted to the base of the simulator; the Analog Switch Board (No. 14118) is attached to the top cover. The two boards are connected by a ribbon cable.
5. Connect a jumper between TP1 (TEST) and TP5 (DGNC) on the CPU and Power Supply Board (No. 7093).

   NOTE: The jumper must remain connected throughout the entire test.

6. Locate the red LED (DS1) on the CPU and Power Supply Board. The LED is positioned at the top of the board midway between the center and the far right.
7. Re-attach the AC power cord and turn on the Model 325 Simulator.
8. Observe the red LED (DS1). The LED illuminates continuously for ten seconds and then flashes on and off. The simulator has passed the test if the LED flashes at least twenty seconds and continues to flash until either the jumper is removed or the simulator is turned off. The simulator has failed the self-test if the LED stops flashing after twenty seconds. Failure of the self-test indicates a problem with the microprocessor, random-access memory (RAM), read only memory (ROM), or timer.
9. Turn off the Model 325 Simulator and remove the AC line cord from the simulator.
10. Re-assemble the two halves of the simulator, replace the top cover, and secure with all four screws.

Table 6-1. General Troubleshooting

PROBLEM	PROBABLE CAUSE	POSSIBLE SOLUTION
No response to **Rate** or **Level** switch settings	**Pattern Memory** switch is ON.	Set **Pattern Memory** switch OFF.
No ultrasound simulation	**ECG Mode** switch is not OFF.	Set **ECG Mode** switch OFF.
No FECG or MECG simulation	**ECG Rate/CMR** switch in CMR position.	Set **ECG Rate/CMR** switch to the left (RATE) position.
No UA simulation	**UA Level/CMR** switch in CMR position.	Set **UA Level/CMR** switch to the left (LEVEL) position.

Theory of Operation

This chapter contains a basic theory of operation for the two circuit boards contained in the Model 325 Simulator. The CPU and Power Supply Board (No. 7093) is mounted on the base of the simulator. The Analog Switch Board (No. 14118) is attached to the top cover, with 13 board-mounted switches protruding through the cover. The two boards are connected by a ribbon cable.

> **NOTE:** An asterisk (*) following a signal name indicates a low true signal.

This chapter describes the following:

CPU and Power Supply Board (No. 7093) 7-2
Analog Switch Board (No. 14118) 7-3

SECTION

7

SECTION 7

CPU AND POWER SUPPLY BOARD (NO. 7093)

Power Supply

AC line power for the simulator enters through connector J3 which protrudes through the rear panel. For 110–120 VAC operation, one 0.2 A slow-blow fuse, F1, is installed in the hot side of the line, and jumper W6 is installed in the neutral side. For 220–240 VAC operation, two 0.2 A super-time lag fuses, F2 and F3, are installed in both sides of the line.

Power passes through the power switch and the line filter before being applied to the primary winding of transformer T1. For 110–120 VAC operation, jumpers W7 and W8 are installed; for 220–240 VAC operation, jumper W9 is installed. One secondary winding is full-wave rectified, filtered, and regulated to provide the +5 V supply. The other secondary winding is full-wave bridge rectified, filtered, and regulated to provide dual +15 V and –15 V supplies. Pin 8 on the secondary winding also supplies a +16 VAC signal to J1 which is used to drive the ECG CMR circuitry on the Analog Switch Board (No. 14118).

Processor Addressing Configuration

The simulator uses an 8085A microprocessor (U2). The eight bits of the processor's address/data bus are input to U3 which latches them with the ALE signal to produce the lower eight bits of the address bus. The three highest order bits are decoded by one half of U12 to provide four chip enables, each containing 2000H addresses. One of these enables is further decoded by the other half of U12 with the next two bits of the address bus to provide four more enables, each containing 800H addresses. An additional enable signal is generated by U7 (pin 8) which inverts the highest-order bit of the address bus. Refer to Table 7-1 for a summary of address selections.

Table 7-1. Processor Addressing

MEMORY ADDRESS (HEX)	DEVICE SELECTION	FUNCTION
0000–1FFF	U4 (2764)	Program PROM
2000–20FF	U6 (8155)	RAM
4000	U11 (7528)	ECG D/A Converter
4001	U11 (7528)	External D/A Converter
6000	U10 (7524)	UA D/A Converter
6800	U15 (7524)	Manual Adjustment A/D Converter
7000	Spare	
7800	Spare	
8000–FFFF	U5 (2756)	HR/UA Pattern PROM
I/O 20	U6 (8155)	Command Register
I/O 21	U6 (8155)	Port A: Switch Inputs
I/O 22	U6 (8155)	Port B: Switch Inputs
I/O 23	U6 (8155)	Port C: Mode Outputs
I/O 24	U6 (8155)	Timer Count, Low Byte
I/O 25	U6 (8155)	Timer Count, High Byte

Watchdog Timer

Approximately every millisecond, on each pass through the main software routine, a positive-going pulse is output on the SOD line of processor U2. This pulse is applied to the trigger input of watchdog timer U11. As long as pulses occur at least every 30 ms, the output of this timer connected to the RST IN* input of the processor, will remain high. If the pulses stop (i.e. the processor has accessed an invalid memory location), the timer produces a negative-going pulse to reset the processor. The timer also makes a similar negative-going pulse on power-up.

Clock Signals

Processor U2 operates on a 6.144 MHz clock, which is divided by two and sent to the clock output. This 3.072 MHz clock signal is fed to the input of the timer on U6, which is programmed to divide it by 1536, resulting in a 2 kHz pulse train on the timer output. This signal is fed to the RST7.5 interrupt line on the processor. This interrupt causes the processor to update the input to the digital-to-analog converters every 500 µs.

Digital-to-Analog Converter Output Circuits

Reference diode D3 provides a 5.00 V reference, buffered by U9 (pin 8), to drive the analog input of both digital-to-analog converters in U11. One stage of op amp U8 (pins 1 and 7) converts the current outputs of the converters to voltages ranging from 0 V to –5 V. Another stage of U8 (pins 8 and 14) scales and offsets these voltages to a –5 V and +5 V range. The analog input for digital-to-analog converter U10 is taken from the +4 V output of the monitor under test. One stage of U9 (pins 1 and 7) converts the current output of the converter to voltage and inverts it to a 0 to +4 V range.

LED and Mode Enable

Port C5 of U6 is used both to provide the TOCO OUT* enable signal and to drive the test LED through buffer transistor Q2. This LED illuminates when the test routine is entered by shorting TP1 to ground. It goes out after a failed test; it flashes after a successful test until the jumper is removed. Nand gates in U7 (pins 3 and 6) provide the ECG* enable signal, which is low when the simulator is either in the FECG or MECG mode.

ANALOG SWITCH BOARD (NO. 14118)

Rate and Level Switch Decoding

The **ECG Rate** switch (S1) shorts one of the nine inputs to U1 to ground or, in the lowest position, leaves all nine inputs pulled up to +5 V. The four output pins of U1 provide a BCD code ranging from 0, when the switch is in the lowest position, to 9, when it is the highest position. The **US Rate** switch (S2) works similarly, except that the code 9 is produced by U2 when the **US Mode** switch (S4) is in the lowest (OFF) position—regardless of the position of S2. Switch S2 may never be placed in the highest position because the slot in the panel is not large enough for the slider to reach this position. The **UA Level** switch (S5) also works similarly except that U3 has only three output pins which produces codes ranging from 0 to 5.

ECG Mode Switching

The **ECG Mode** switch, S3, may never be placed in the lowest position because the slot in the panel is not large enough for the slider to reach this position. The next position (OFF) leaves both FECG*IN and MECG*IN lines pulled up to +5 V. The next two positions (FECG and MECG) ground the FECG*IN and MECG*IN lines, respectively.

Line Frequency Signal Generator

The output of the secondary windings, entering at J1 (pin 28), is divided by R53 and R54 to keep it within the common-mode input range of U4. The first stage of U4 (pin 8) is used as a comparator with positive feedback for hysteresis. The output at U4 (pin 8) is a square wave at line frequency with an amplitude determined by the output saturation voltage of U4, regardless of changes in line voltage. Potentiometer R57 is used to adjust the amplitude of the line frequency signal. The signal is then fed through the remaining three stages of U4, which are configured as a six-pole, 0.5 dB Chebyshev, low-pass filter with a cutoff frequency of 67 Hz. The signal at U4 (pin 7) is a line-frequency sine wave with a peak-to-peak amplitude of 20 V.

ECG Signal Control

The output of the ECG digital-to-analog converter, entering at J1 (pin 24) is fed to inverter U5 (pin 1). The **QRS Polarity** switch, S11, selects the inverted or non-inverted ECG signal. The signal at this point has a peak amplitude of 3.5 V. The resistive divider feeding the **ECG QRS Amplitude** switch, S9, is arranged so that each 1 kΩ of resistance between U5 (pin 12) and ground yields 10 mV of peak signal at U5 (pin 12). After buffering by U5 (pin 14), the signal is fed to two 1000:1 dividers. Thus each 1 mV of signal at U5 (pin 7) corresponds to 1 μV sensed by the maternal/fetal monitor. The divider consisting of R62, R64, and R72 provides ECG LA, RA, and RL signals. The signals pass through the **ECG Rate/CMR** switch (S8), which connects the ECG signals to the maternal/fetal monitor when it is in the left (RATE) position, or the sine wave for the CMR test when it is in the right (CMR) position.

Ultrasound and Fetal Movement Detection

The carriers for the ultrasound and fetal movement signals are generated from the division of two 4 MHz crystal oscillators (X1 and X2) set to specific offsets from the ultrasound operating frequency of the maternal/fetal monitor (200 Hz for the heart rate signal and 25 Hz for the fetal movement detection signal). These offsets produce detected signals that fall within the monitor's operational passband for both of these modes.

The ultrasound heart rate signal is gated on and off by a comparator (U6) to produce a countable heart rate in the maternal/fetal monitor. This comparator is triggered by an analog waveform generated by a digital-to-analog converter on the Power Supply and CPU Board (No. 7093). This waveform is a representation of the fetal heart rate signal. The amplitude variations in this signal are filtered out by an RC lowpass filter (R37 and C7), and the peak amplitude of the filtered waveform is limited to 5 V by a zener diode (D4). **Signal Level** switch S10 sets the output level (HIGH, MED, LOW) of the ultrasound signal. This switch controls the number of NAND gates which are enabled to drive the output stage. A single gate, U10 (pin 11), drives the output stage in the low position; two gates, U10 (pins 6 and 8), are used in the MED position; and four gates, U10 (pins 3, 6, 8, and 11), are used in the HIGH position. These drive gates connect to a tapped inductor parallel resonate tuned circuit through 1 kΩ resistors (R16–R19) and a 0.1 μF capacitor (C13). The resistors connect to the low impedance tap on the tuned circuit. The more gates active, the more current is applied to the tuned circuit, and the larger the output at the high impedance point. This tuned circuit serves as both a summing node for the gate drivers and a filter to the output, converting the square wave output from the gates to sine waves. The signal present at the high impedance tap on the tuned circuit is divided down in amplitude with a two-stage attenuation network (R20, R21 and R22, R24). The output of the network connects to the ultrasound transducer input of the maternal/fetal monitor.

The fetal movement output is generated in much the same way as the ultrasound signal. It uses the same NAND gate drive to a tapped tuned circuit; however, when this mode is activated by switching the **US Mode** switch (S4) to the US/FMD position, a single drive gate, U11 (pin 8), is turned on simultaneously. This is required to provide a background signal level to the monitor's fetal movement detection circuitry. Three other drive gates, U11 (pins 3, 6, and 11), are turned on and off by a control signal generated by decoding the outputs from the divisions of the fetal movement 4 MHz oscillator. This produces the simulated fetal movement event. The control signal turns the remaining drive gates on for about one second and off for about eight seconds. This produces a fetal movement detection mark on the monitor's strip chart paper every eight seconds. The high impedance output from the fetal movement tuned circuit is attenuated by a 10 kΩ series resistor (R49) which connects to the second stage of the ultrasound attenuation network. This serves as the summing point for the two ultrasound signals.

Pressure Circuitry

The output of the UA digital-to-analog converter at J1 (pin 26) provides 3.125 V (4 V x 200/256) for a reading of 100 mmHg or relative units. This is divided down to 2 mV by R78 and R84, then fed to the UA+ input of the monitor when the **UA Level/CMR** switch (S12) is in the left (LEVEL) position. When the switch is in the right (CMR) position, both the UA+ and UA– inputs are connected to 0.1 V which is derived from the +4 V UA reference voltage.

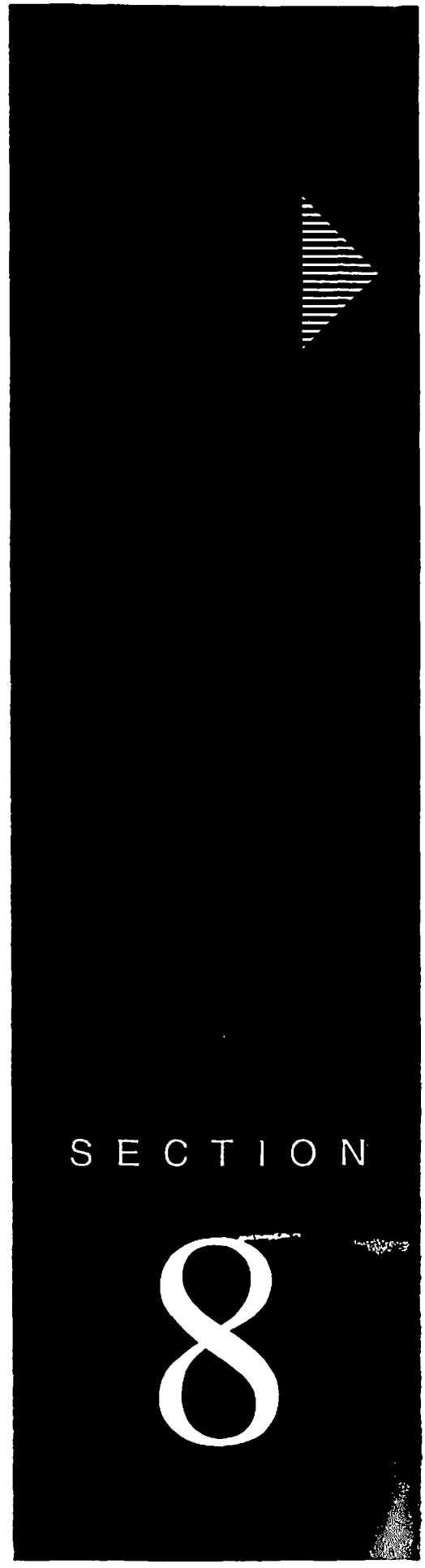
When the simulator is in the TOCO mode, the TOCO*OUT line at J1 (pin 22) is low. This turns on transistor Q1, grounding the TOCO* line to the monitor at J4 (pin 4). It also turns off Q3, bringing its collector to approximately 3.2 V. This allows R82 to be adjusted to provide a negative offset to the UA signal. When the simulator is in the IUP mode, the TOCO*OUT line is high. This turns on Q2 allowing the IUP* line to be pulled up in the monitor. It also turns on Q3, effectively eliminating the negative UA offset. Turning on Q3 also loads the +4 V reference with R87; when the monitor senses the current drawn by R87, it enters IUP mode. An IUP enable line is provided for those maternal/fetal monitors which do not have the current sensing capabilities.

Specifications

This section contains a detailed list of the technical specifications for the Model 325 Simulator.

This chapter lists specifications for the following:

Power Requirements 8-2
Physical Characteristics 8-2
Environmental Conditions 8-2
ECG 8-2
US 8-2
UA 8-3
Interconnection Cables 8-3



SECTION 8

POWER REQUIREMENTS

Nominal Line Voltage:	100–120 VAC	220–240 VAC
Line Voltage Range:	90–132 VAC	180–250 VAC
Line Frequency:	50/60 Hz	50/60 Hz
Power Consumption (maximum):	15 W	15 W

PHYSICAL CHARACTERISTICS

Height:	3.6 in (9.1 cm)
Width:	10.1 in (25.7 cm)
Depth:	8.6 in (21.8 cm)
Weight:	4.0 lbs (1.8 kg) approx.

ENVIRONMENTAL CONDITIONS

	Operating	Storage
Ambient Temperature:	50°F to 104°F (10°C to 40°C)	14°F to 131°F (–10°C to 55°C)
Relative Humidity:	10% to 95%, non-condensing	0% to 95%, non-condensing

ECG

Modes:	FECG, MECG
Rates:	
Fixed:	30, 60, 120, 210, 240 BPM, ±0.2 BPM
Deltas:	15, 22, 27 BPM ±0.2 BPM
Ramp:	30–240 BPM ±0.2 BPM at 3 BPM/sec ± 0.01 BPM/sec
Manual:	30–240 BPM
Patterns:	Stored in internal PROM
Polarity:	Positive, Negative
QRS Complex Amplitude:	12, 15, 50, 100, 500, 2000 µV ± 5%
QRS Complex Width:	Width of complex remains constant at all ECG rates.
Common Mode Rejection Test:	20 V peak-to-peak ± 5% at line frequency, balanced and 5kΩ unbalanced

US

Modes:	US, US/FMD
Rates:	
Fixed:	50, 60, 120, 210 BPM ±0.2 BPM
Deltas:	15, 22, 27 BPM ±0.2 BPM
Ramp:	50–210 BPM ±0.2 BPM at 3 BPM/sec ± 0.01 BPM/sec
Manual:	30–240 BPM
Patterns:	Stored in internal PROM.
Amplitude:	Low, medium, and high signal levels
Waveform Envelope:	Stored in PROM. Width of pulse varies with rate.

UA

Modes:	IUP, TOCO
Level:	
Fixed:	0, 10, 50, 100 mmHg ± 1 mmHg, or relative units ± 1 relative unit
Ramp:	0–100 mmHg ± 1 mmHg or relative units ± 1 relative unit
Manual:	0 to greater than 100 mmHg or relative units
Patterns:	Stored in internal PROM
Common Mode Rejection Test:	0.1 Vdc ± 2%

INTERCONNECTION CABLES

2.5-foot Length:	Part No. 14212A
6-foot Length:	Part No. 14212B

Drawings

This section of the manual provides schematics, assembly drawings, and parts lists for the Power Supply and CPU Board (No. 7093) and the Analog Switch Board (No. 14118), as well as other related drawings.

The following information pertains to the reference drawings provided in this section:

General Information 9-2
Parts Replacement 9-2

SECTION

9

SECTION 9

GENERAL INFORMATION

The Corometrics factory makes every effort possible to provide the most up-to-date reference documentation for your Corometrics equipment. However, in special cases involving field-installed upgrades, the revision level of a schematic, assembly drawing, or parts list in this manual may not reflect the revision level of your unit. When discrepancies are found, contact the Corometrics Service Department at one of the numbers below:

- Inside the United States:
  1-800-808-CORO (2676)

- Outside the United States:
  (203) 284-2498;
  or contact your local distributor

PARTS REPLACEMENT

The Model 325 Simulator employs standard electrical components and hardware when practical. However, certain subassemblies may require special components which are available through Corometrics. Material contained in this section is intended for general reference use only and not for direct ordering of replacement parts. Questions regarding the suitability or nature of a replacement part should be resolved with the Corometrics Service Department. To expedite the clarification process, it is suggested that the following steps be taken:

1. Obtain the serial number listed on the unit.
2. Note any identification data on the subassembly in question. Printed circuit boards are identified by a code printed along one edge of the board.
3. Locate and identify any components in question by referring to the assembly drawing and the associated parts list presented in this section.

Finally, call the Corometrics Service Department at one of the numbers listed above in *General Information*

REV	ECN	DESCRIPTION	DFT	DATE	CHKD	APPD
*	0A80	CHG TO AGREE	RL	6.94	BS	RJO

PART NO.	REV	DESCRIPTION
7093EC	04	120V F1, W6, W7, W8
7093FC	04	240V F2, F3, W9

HIGHEST COMP REF. DESIG.	UNUSED
R21	
C34	
Q2	
D7	
TP10	
U19	
RN3	

NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTANCE IS IN OHMS.
2. * DENOTES 1/8W, 1% RESISTORS.
3. CAPACITANCE IN IN MICROFARADS.
4. ALL RESISTORS ARE 1/4W, 5%.
5. ** DENOTES 1/8W, 0.1%.
6. CONN. J2 FOR TESTING ONLY.

SPARES

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DO NOT SCALE - WORK TO DIMENSIONS SHOWN
REMOVE BURRS, BREAK SHARP EDGES & CORNERS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONS ±
2 PLACE DECIMALS ±
3 PLACE DECIMALS ±
ANGLES ±

NEXT ASSY	USED ON
C7093E	305
C7093F	305

APPLICATION

COROMETRICS® MEDICAL SYSTEMS, INC.
BARNES INDUSTRIAL PARK
WALLINGFORD, CONNECTICUT

DRAWN	R. LIBBY	DATE 6.13.94
CHECKED	B. SHATTUCK	DATE 8.30.93
ENGINEER	P.S.	DATE 9.17.93
APPROVED	BOC	DATE 9.17.93

TITLE: SCHEMATIC
305 CPU BOARD

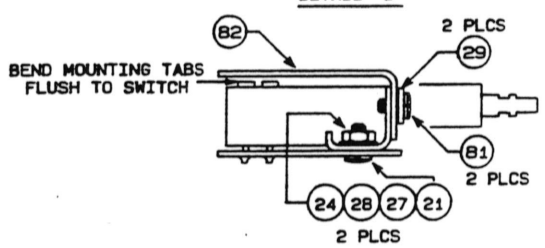
MATERIAL | FINISH

SIZE	DRAWING NUMBER	REV.
D	7093 TAB	*

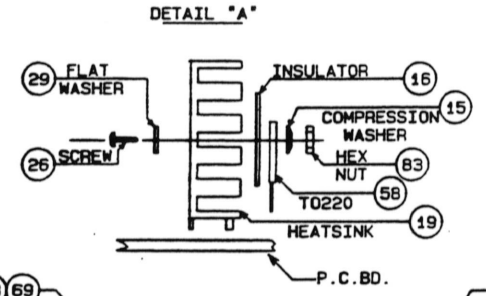
SCALE ~ | SHEET 1 OF 1

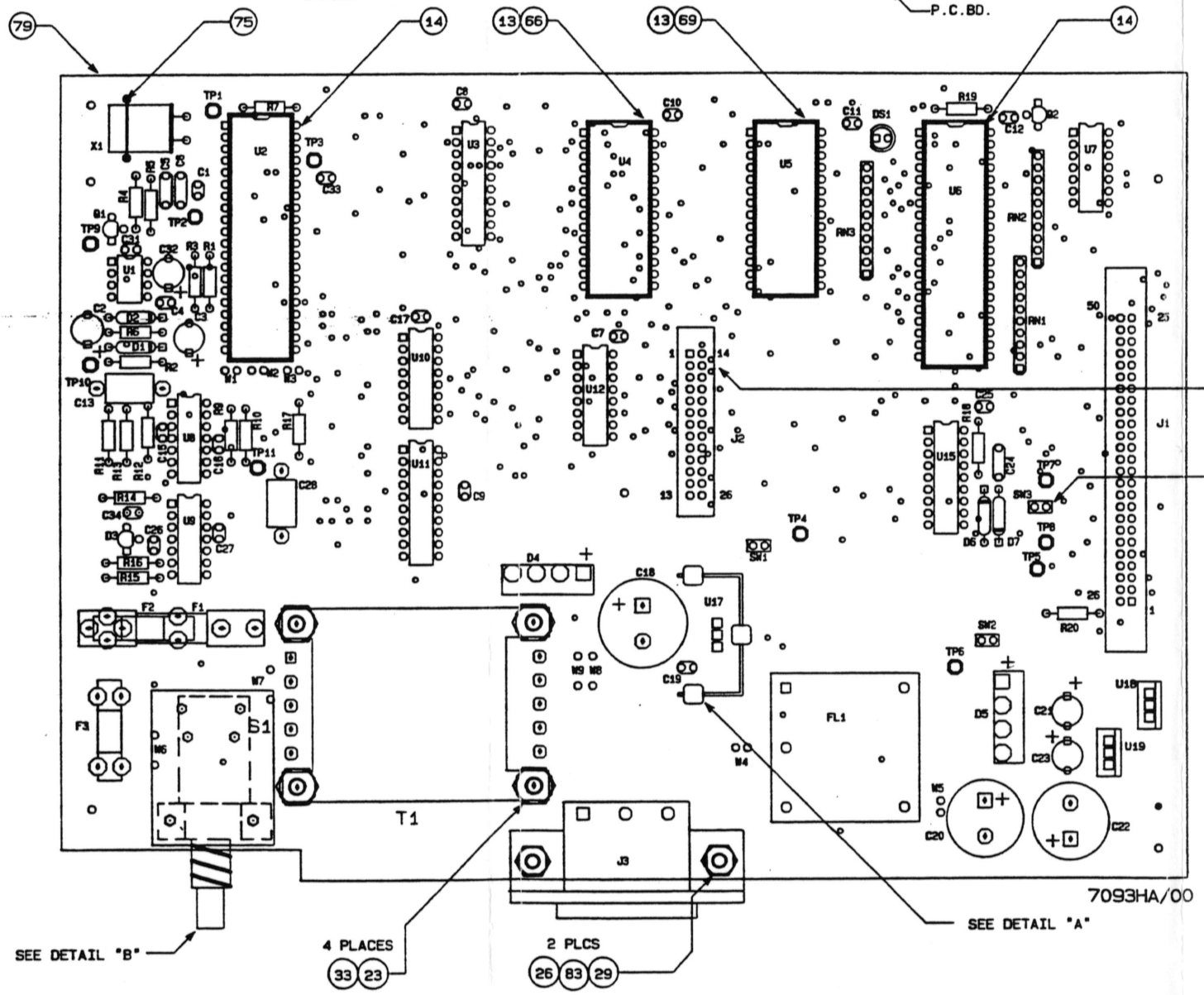
REV	ECN	DESCRIPTION	DFT	DATE	CHKD	APPD
*	9835	RMV SW. AT SW1-3, ADD HDR AT SW1-3	RL	3-94	BS	
*	0A80	CHG TO AGREE	RL	6-94	BS	RMP

DETAIL "B"



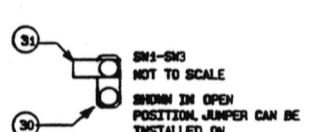
DETAIL "A"



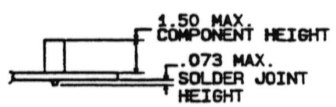


NOTES:

1- OBSERVE POLARITY AND ORIENTATION MARKINGS OF ALL COMPONENTS.
2- INSERT COMPONENTS FULLY INTO BOARD.
3- FOR SCHEMATIC DRAWING SEE 7093EC, FC.
4- STORE IN ANTISTATIC BAG P/N 410080 - NOT SHOWN.
5- FOR PARTS LIST SEE P/L 7093E, F.
6- ITEM 78, BUTTON AND ITEM 20, HITCH PIN NOT SHOWN.



PART NO.	REV	DESCRIPTION
7093E	04	120V F1, W6, W7, W8
7093F	04	240V F2, F3, W9



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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONS ±
2 PLACE DECIMALS ±
3 PLACE DECIMALS ±
ANGLES ±

NEXT ASSY	USED ON
D7227TAB	305

APPLICATION

DRAWN	R. LIBBY	DATE 3-16-94
CHECKED	B. SHOTWELL	DATE 6-30-93
ENGINEER	PS	DATE
APPROVED	R. O'Connell	DATE 9/17/93

MATERIAL	FINISH
-	-

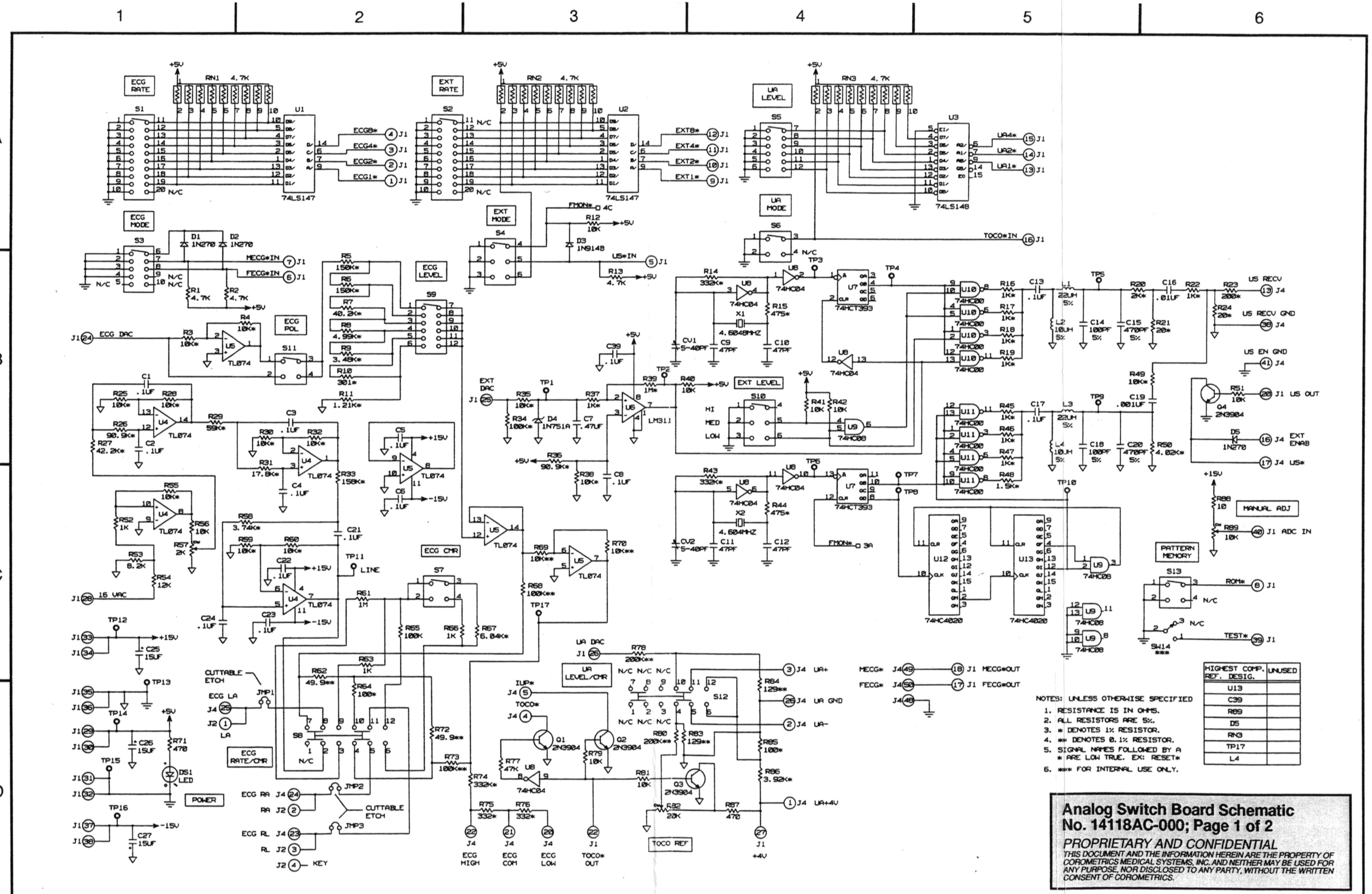
COROMETRICS® MEDICAL SYSTEMS, INC.
BARNES INDUSTRIAL PARK
WALLINGFORD, CONNECTICUT

TITLE ASSEMBLY DWG
305 CPU BOARD

SIZE	DRAWING NUMBER	REV.
C	7093TAB	*

SCALE 1.25:1 SHEET 1 OF 1

BRUNING 7124 FORM # 6826



HIGHEST COMP. REF. DESIG.	UNUSED
U13	
C39	
R89	
D5	
RN3	
TP17	
L4	

NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTANCE IS IN OHMS.
2. ALL RESISTORS ARE 5%.
3. * DENOTES 1% RESISTOR.
4. ** DENOTES 0.1% RESISTOR.
5. SIGNAL NAMES FOLLOWED BY A * ARE LOW TRUE. EX: RESET*
6. *** FOR INTERNAL USE ONLY.

Analog Switch Board Schematic
No. 14118AC-000; Page 1 of 2

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1 2 3 4 5 6

A

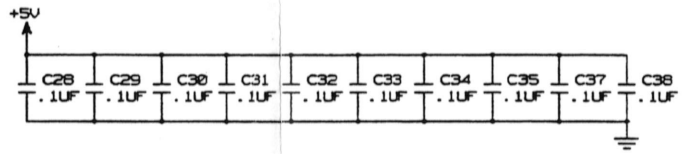
B

C

D

UNDEFINED POWER AND GROUND TABLE

DESCRIPTION	REF DES	VOLTAGE PIN(S)		RETURN PIN(S)	
74HC00	U10, 11	14	+5V	7	GND
74HC04	U8	14	+5V	7	GND
74HC08	U9	14	+5V	7	GND
74HCT393	U7	14	+5V	7	GND
74LS147	U1, 2	16	+5V	8	GND
74LS148	U3	16	+5V	8	GND
74HC4020	U12, 13	16	+5V	8	GND



Analog Switch Board Schematic
No. 14118AC-000; Page 2 of 2

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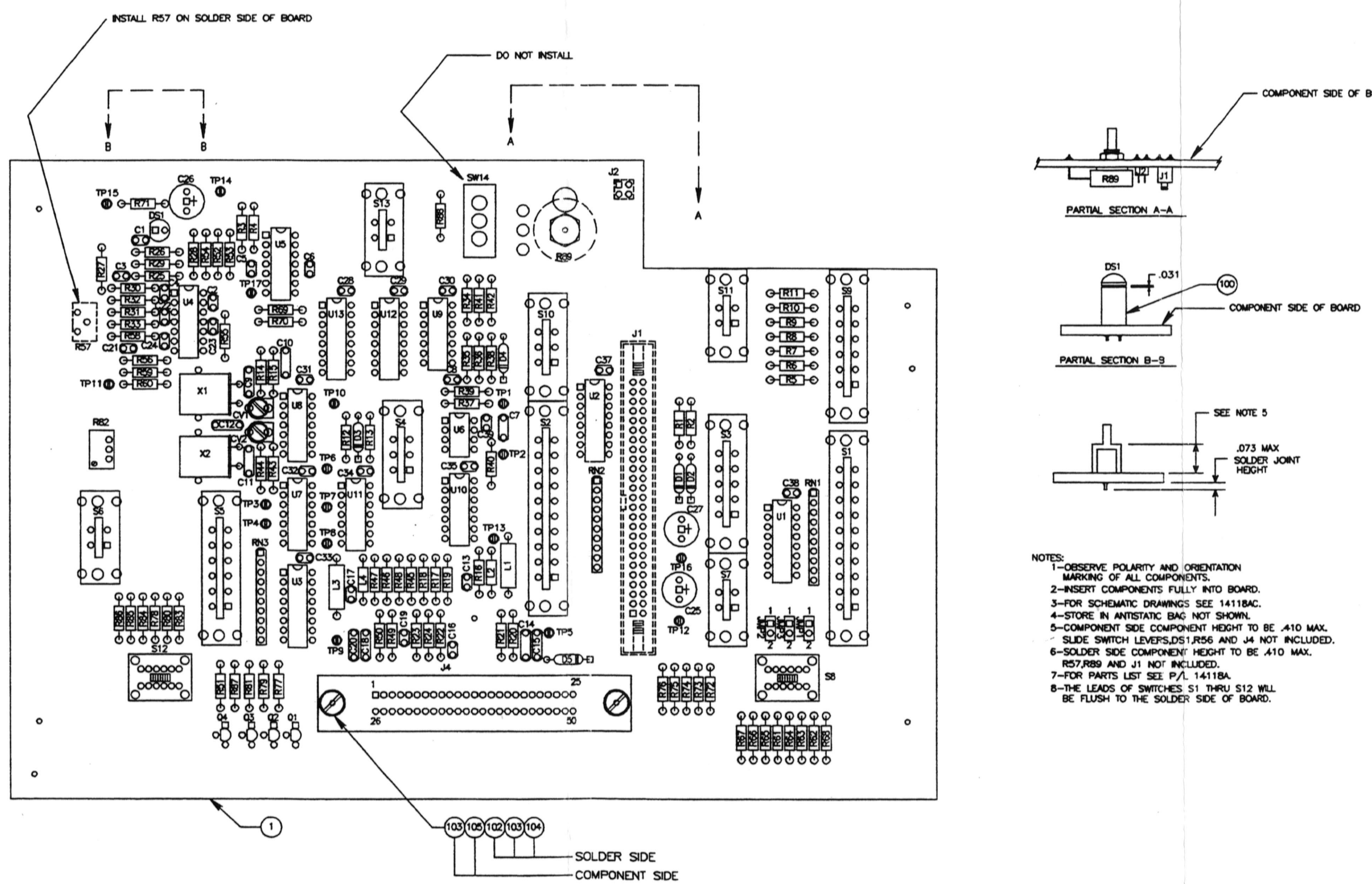

NOTES:
1–OBSERVE POLARITY AND ORIENTATION MARKING OF ALL COMPONENTS.
2–INSERT COMPONENTS FULLY INTO BOARD.
3–FOR SCHEMATIC DRAWINGS SEE 14118AC.
4–STORE IN ANTISTATIC BAG NOT SHOWN.
5–COMPONENT SIDE COMPONENT HEIGHT TO BE .410 MAX. SLIDE SWITCH LEVERS,DS1,R56 AND J4 NOT INCLUDED.
6–SOLDER SIDE COMPONENT HEIGHT TO BE .410 MAX. R57,R89 AND J1 NOT INCLUDED.
7–FOR PARTS LIST SEE P/L 14118A.
8–THE LEADS OF SWITCHES S1 THRU S12 WILL BE FLUSH TO THE SOLDER SIDE OF BOARD.

Analog Switch Board Assembly
No. 14118A-000; Page 1 of 1

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